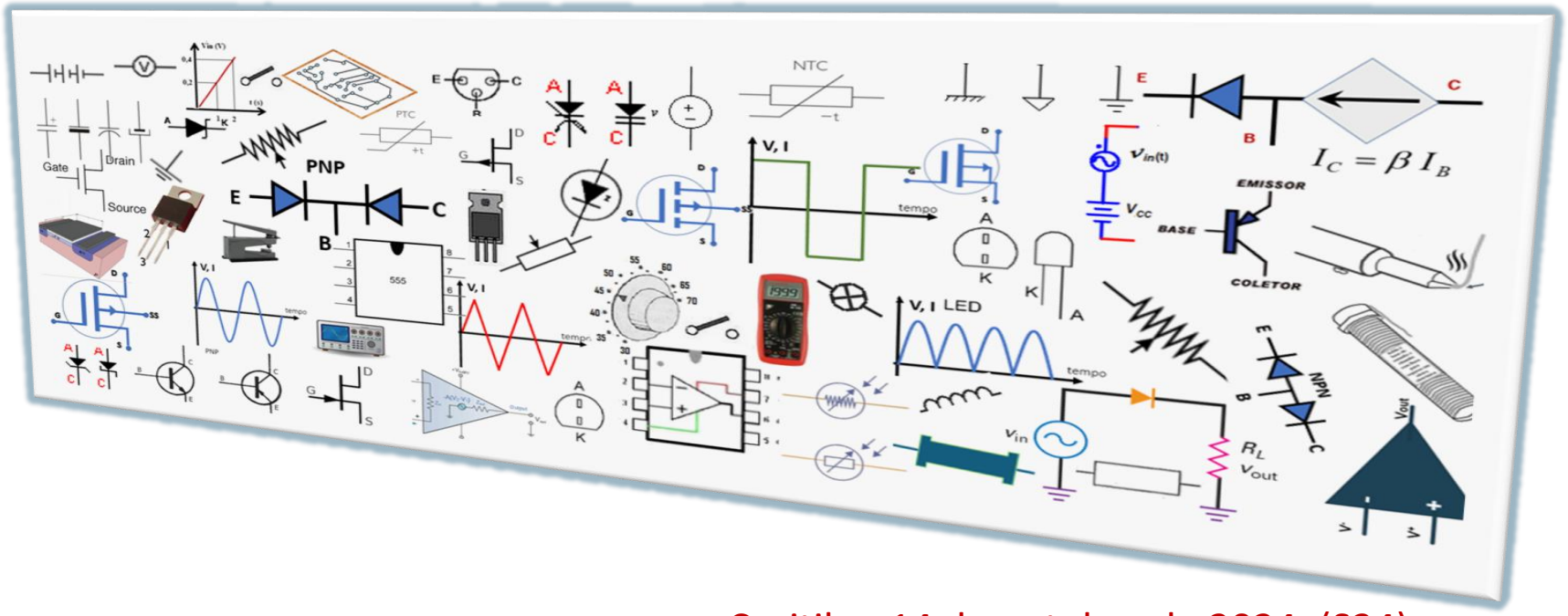
APLICAÇÕES COM DIODOS

AOS04.2- PORTAS LÓGICAS: OU e E - CEIFADOR



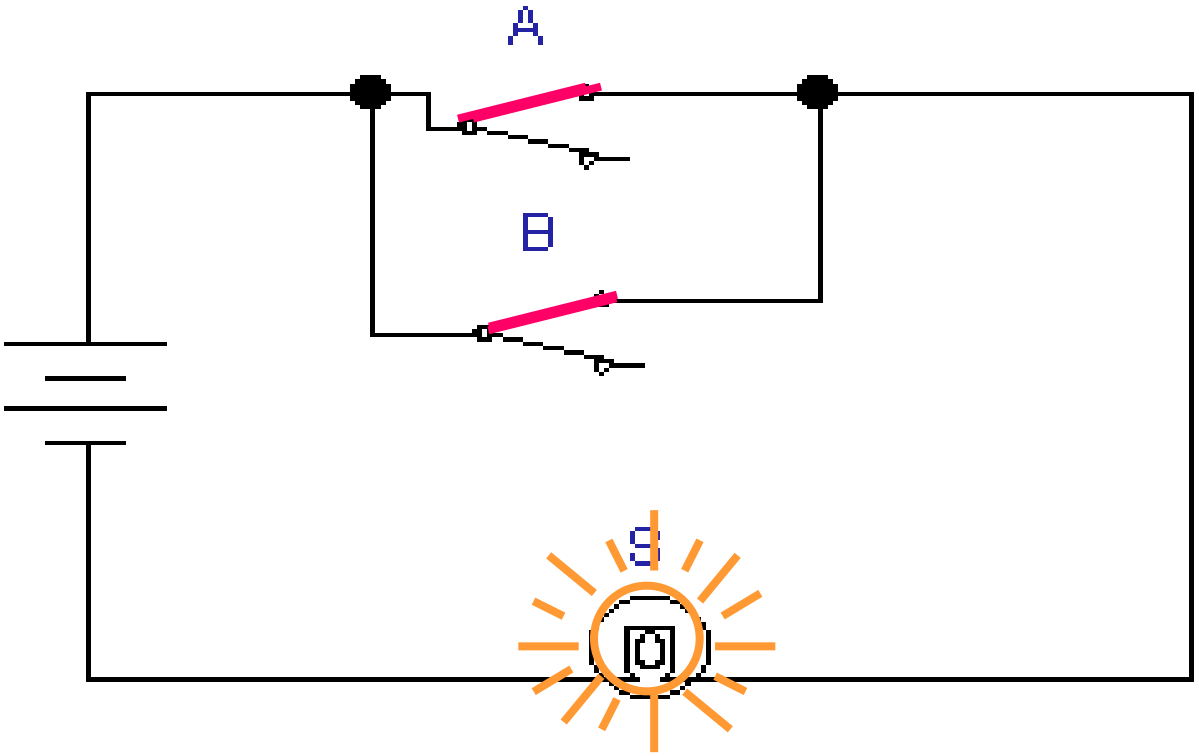
Curitiba, 14 de outubro de 2024. (S24)
Curitiba, 15 de outubro de 2024. (S25 e S26)

AGENDA

1. Porta OU, E
2. Ceifador

Conteúdo BLOCO MOODLE➔ Materiais de Apoio Atividade EAD
Circuitos com diodos em https://moodle.utfpr.edu.br/mod/book/view.php?id=1753523

Porta lógica “OU”- equivalente elétrico

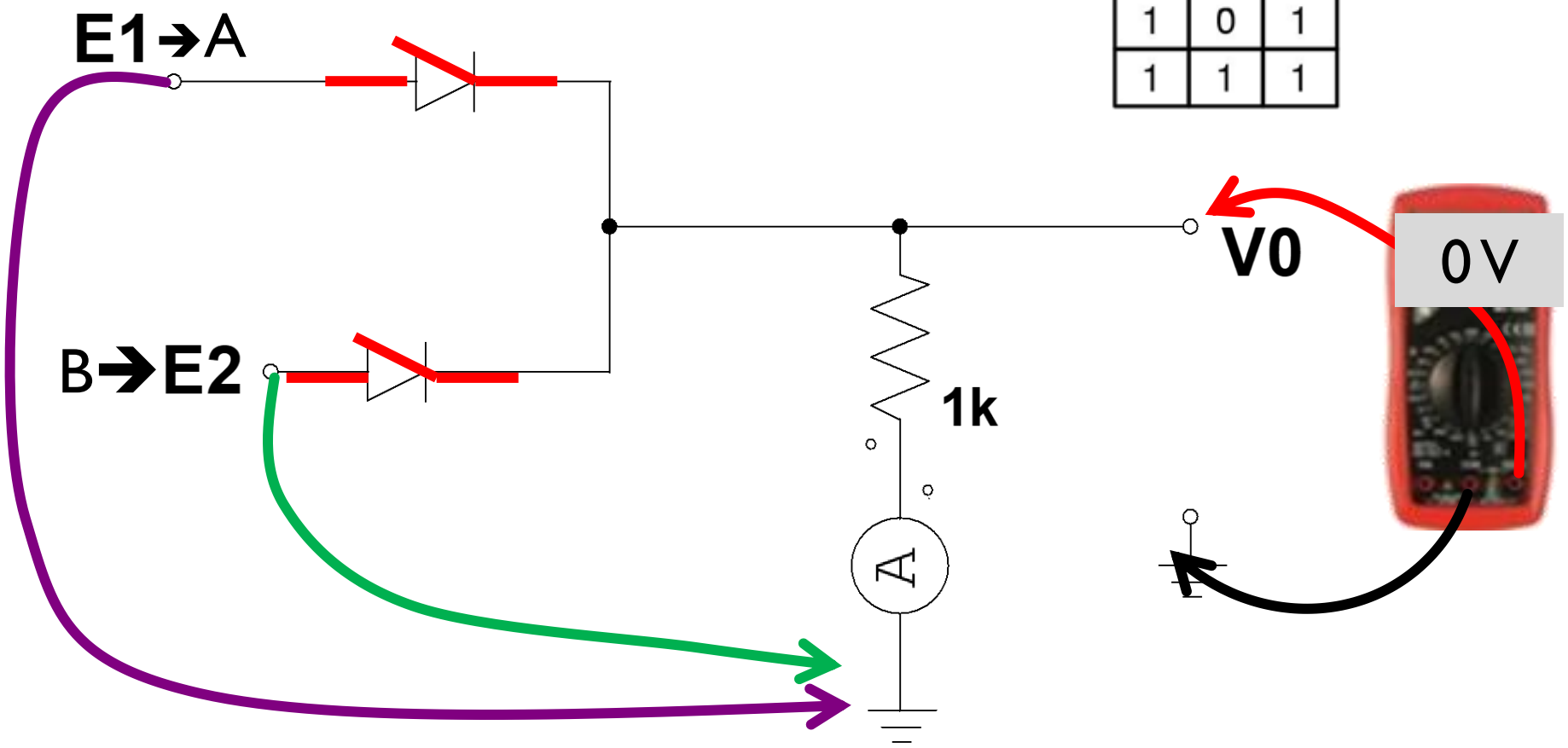


B	A	S
0	0	0
0	I	I
I	0	I
I	I	I

Porta lógica “OU” com diodo

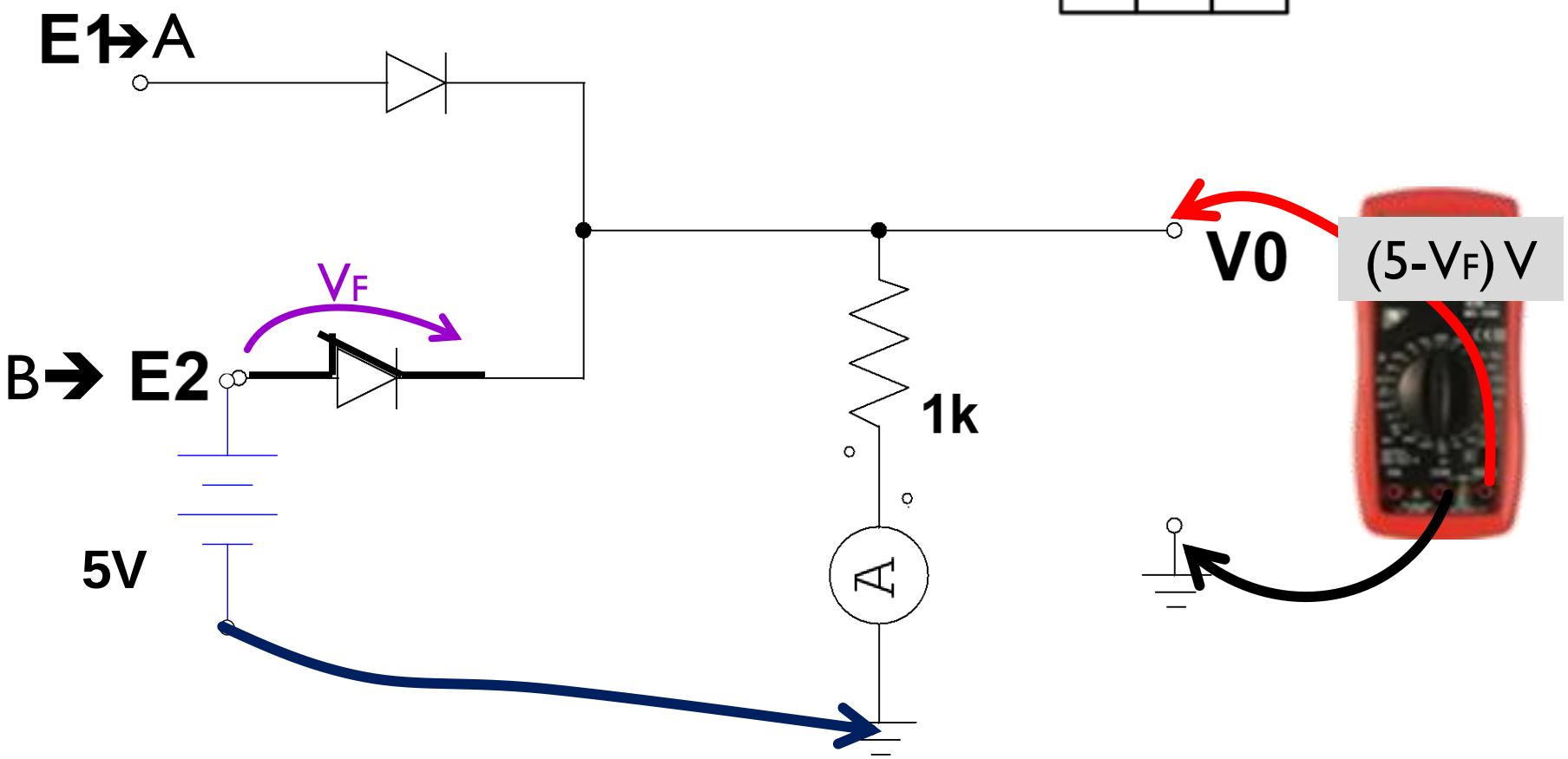
Sistema digital:
“0” representa **ausência** de potencial superior a V_F.
“1” representa **presença** de potencial superior a V_F.

A	B	Vo
0	0	0
0	1	1
1	0	1
1	1	1



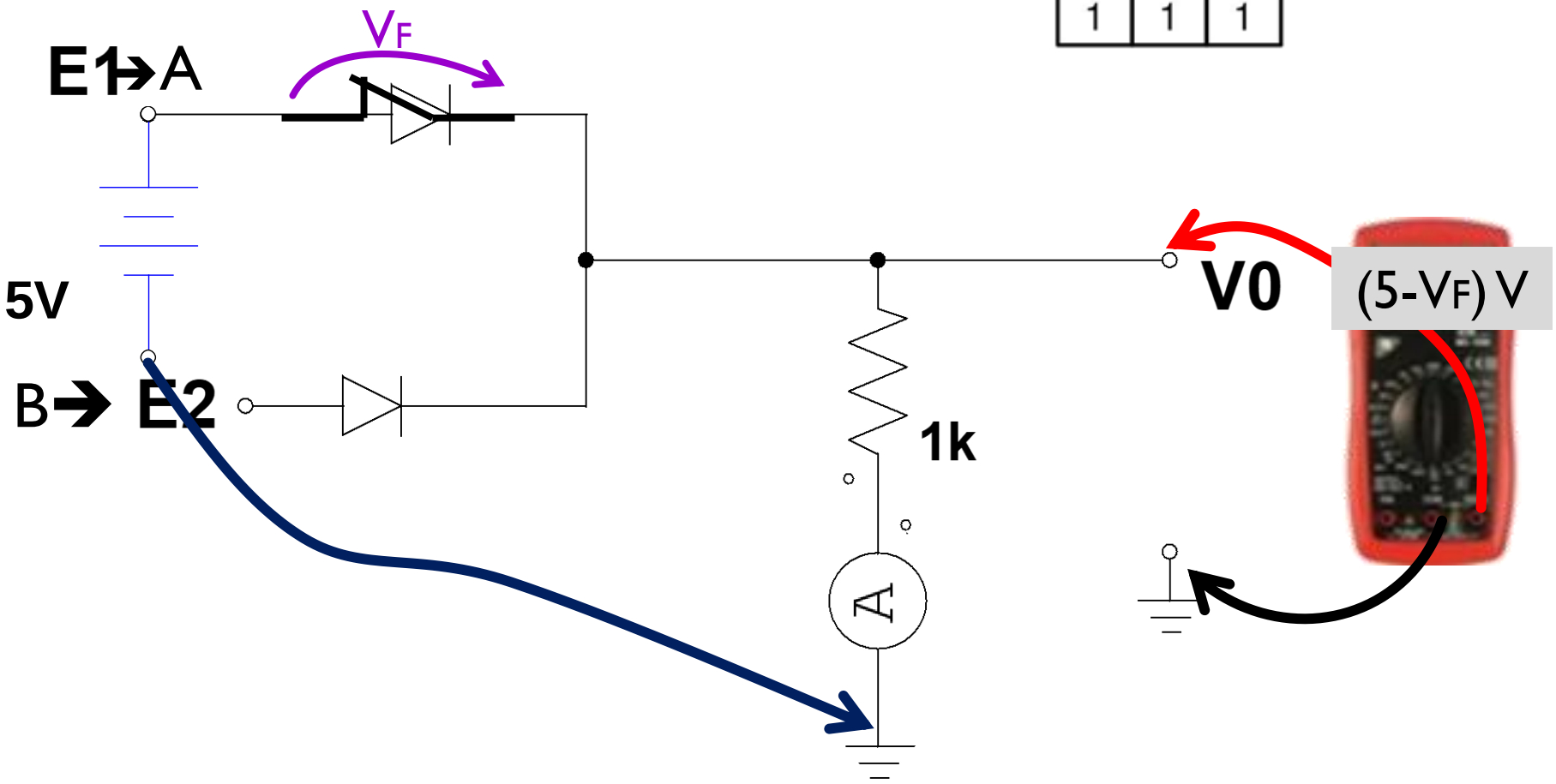
Porta lógica “OU” com diodo

A	B	Vo
0	0	0
0	1	1
1	0	1
1	1	1



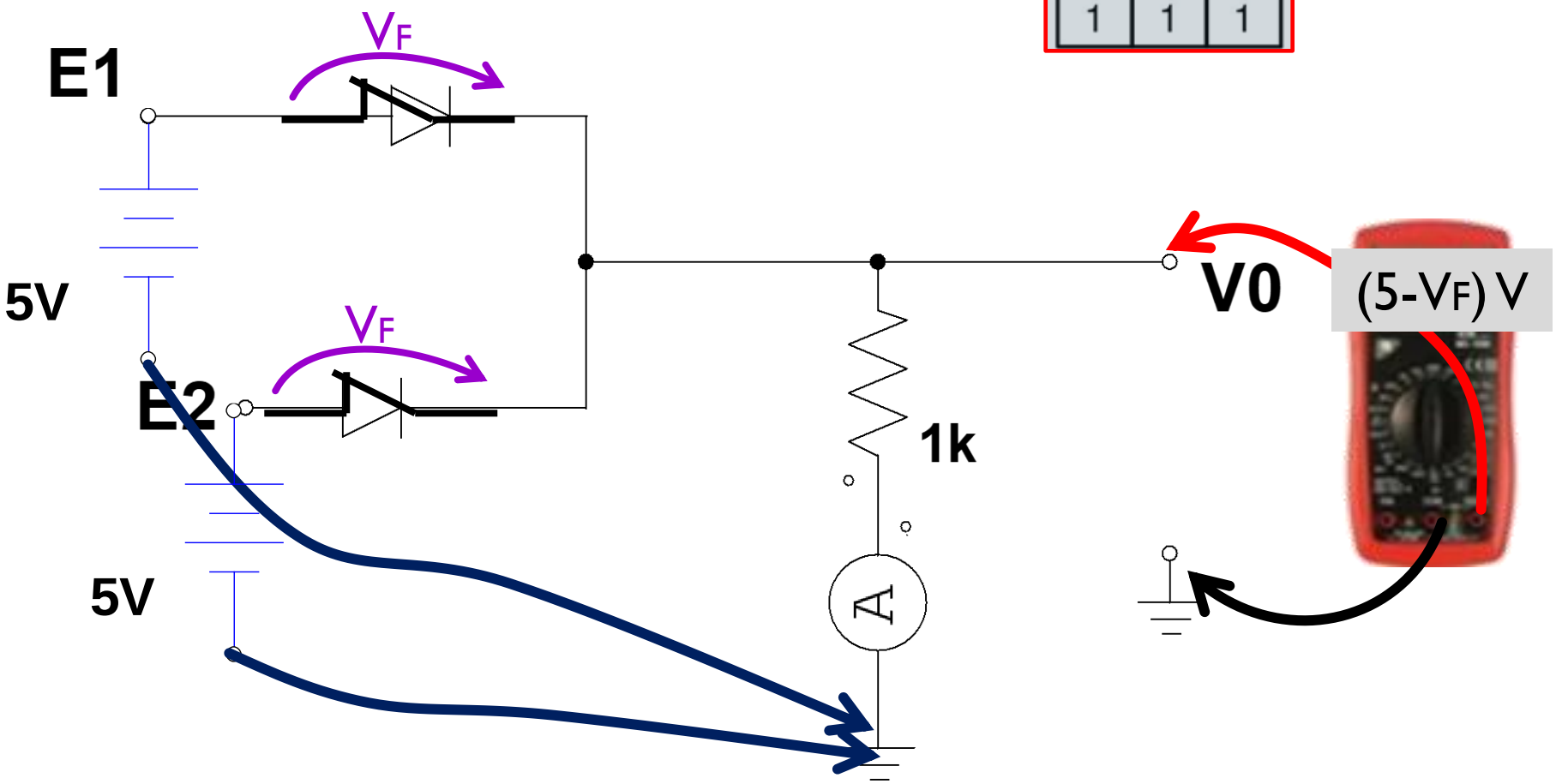
Porta lógica “OU” com diodo

A	B	Vo
0	0	0
0	1	1
1	0	1
1	1	1



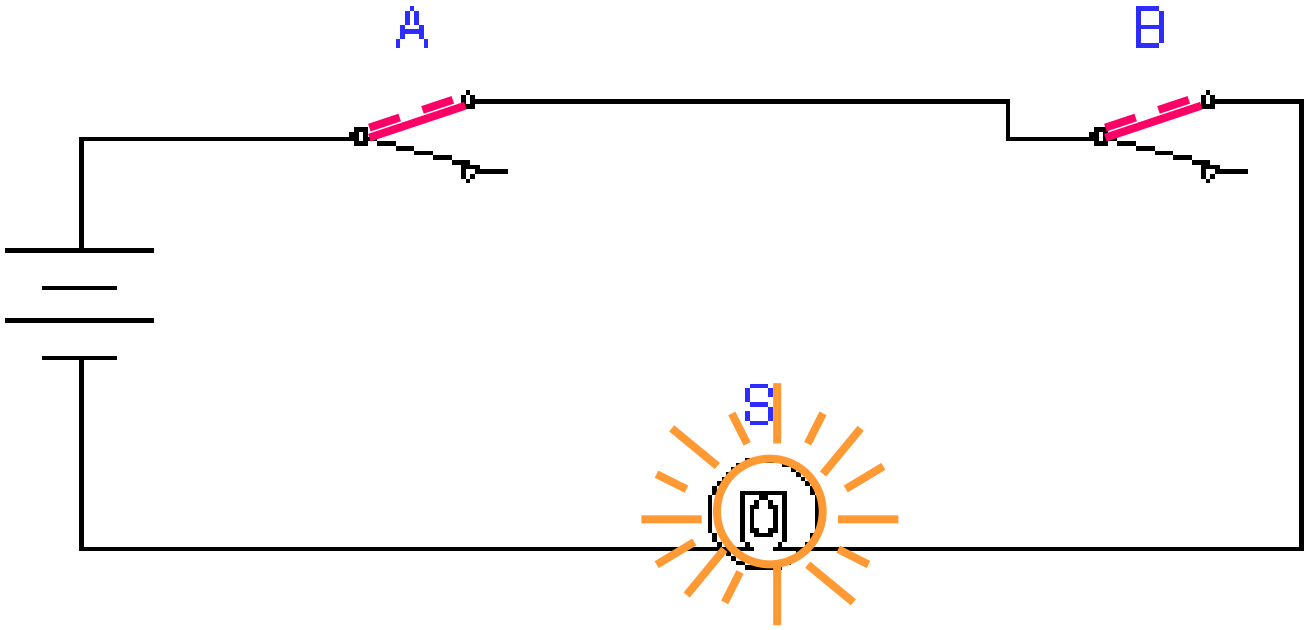
Porta lógica “OU” com diodo

A	B	Vo
0	0	0
0	1	1
1	0	1
1	1	1



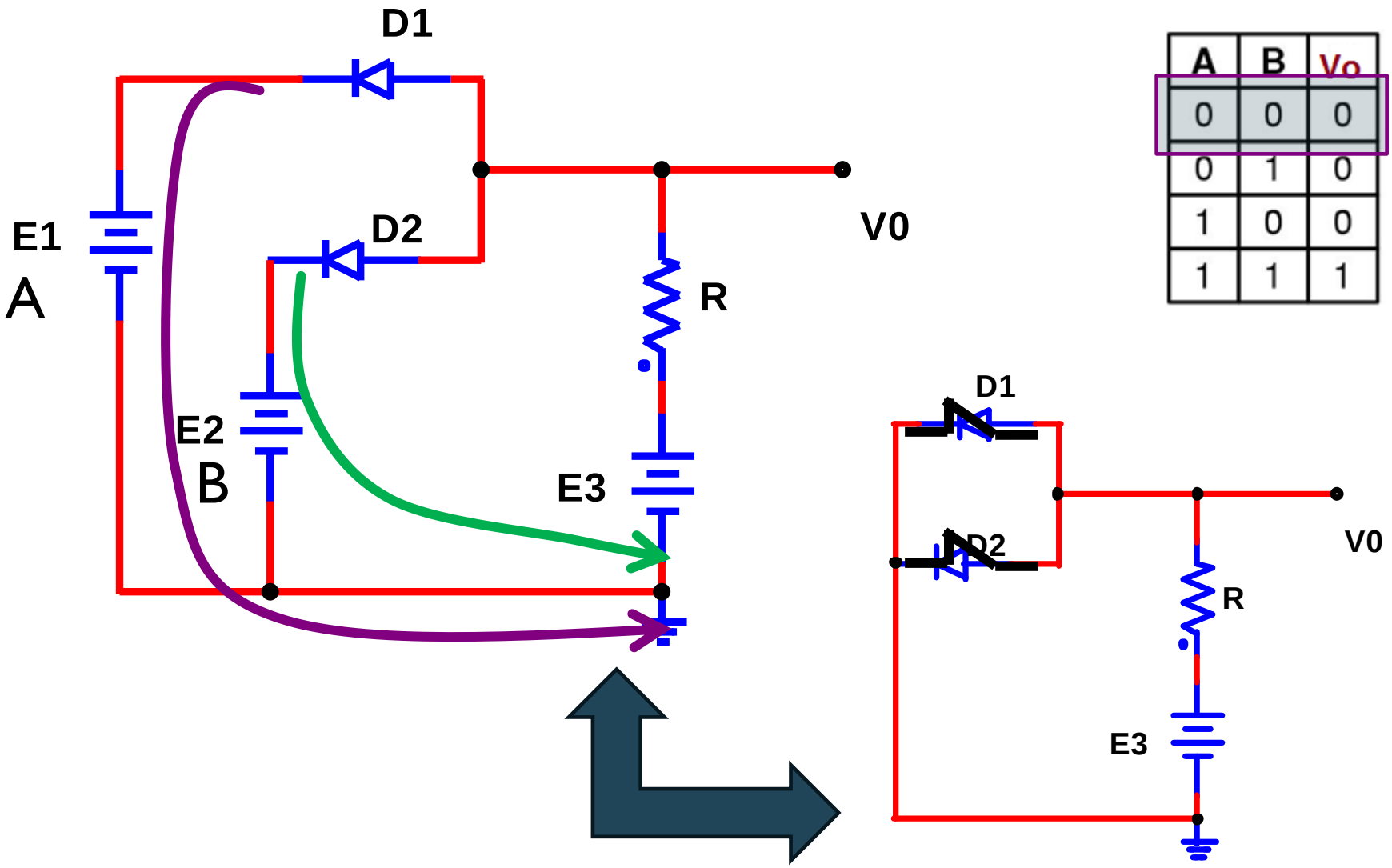
Porta lógica “E”- equivalente elétrico

i)



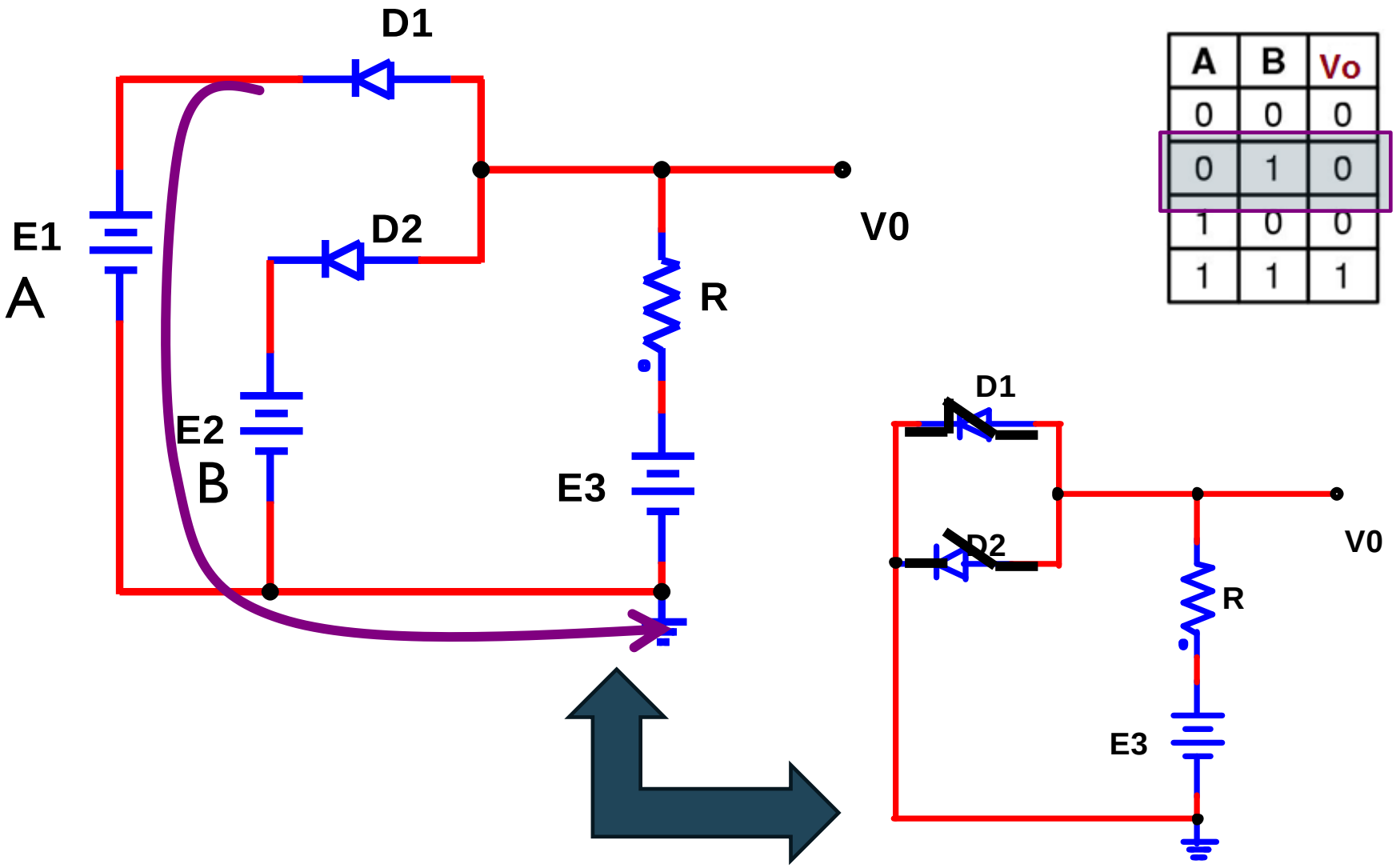
A	B	S
0	0	0
0	1	0
1	0	0
1	1	1

Porta lógica “E”



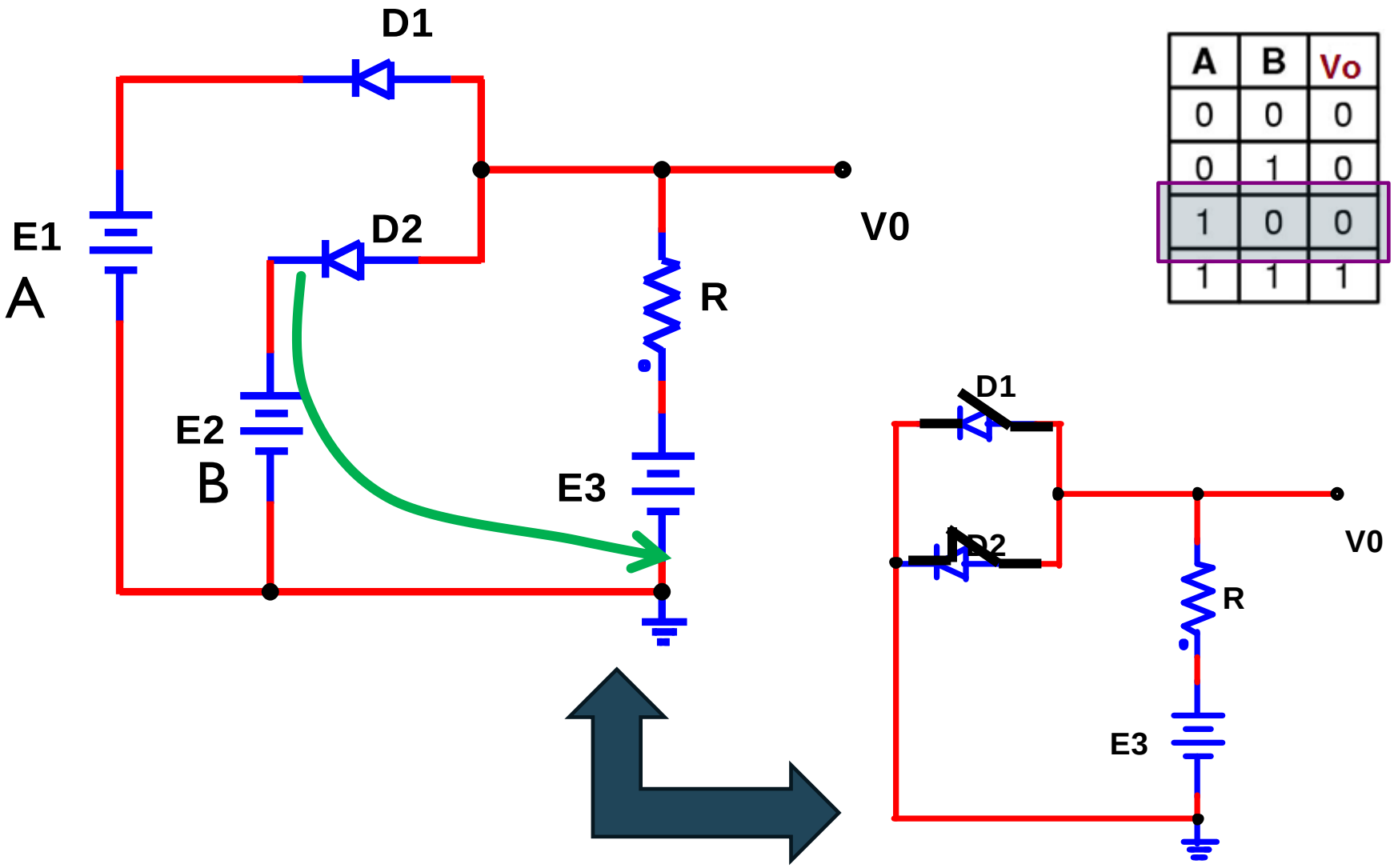
A	B	Vo
0	0	0
0	1	0
1	0	0
1	1	1

Porta lógica “E”



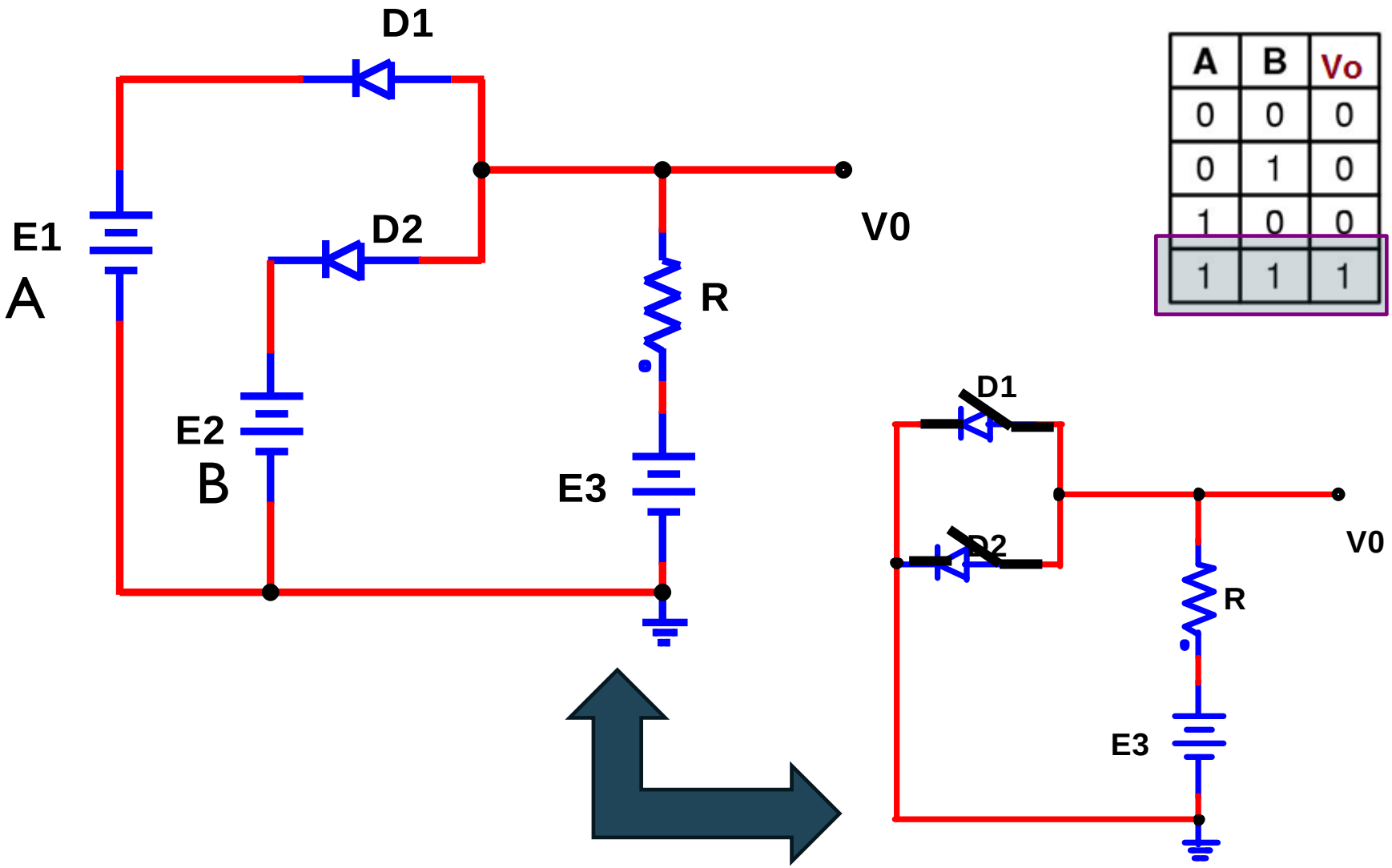
A	B	Vo
0	0	0
0	1	0
1	0	0
1	1	1

Porta lógica “E”



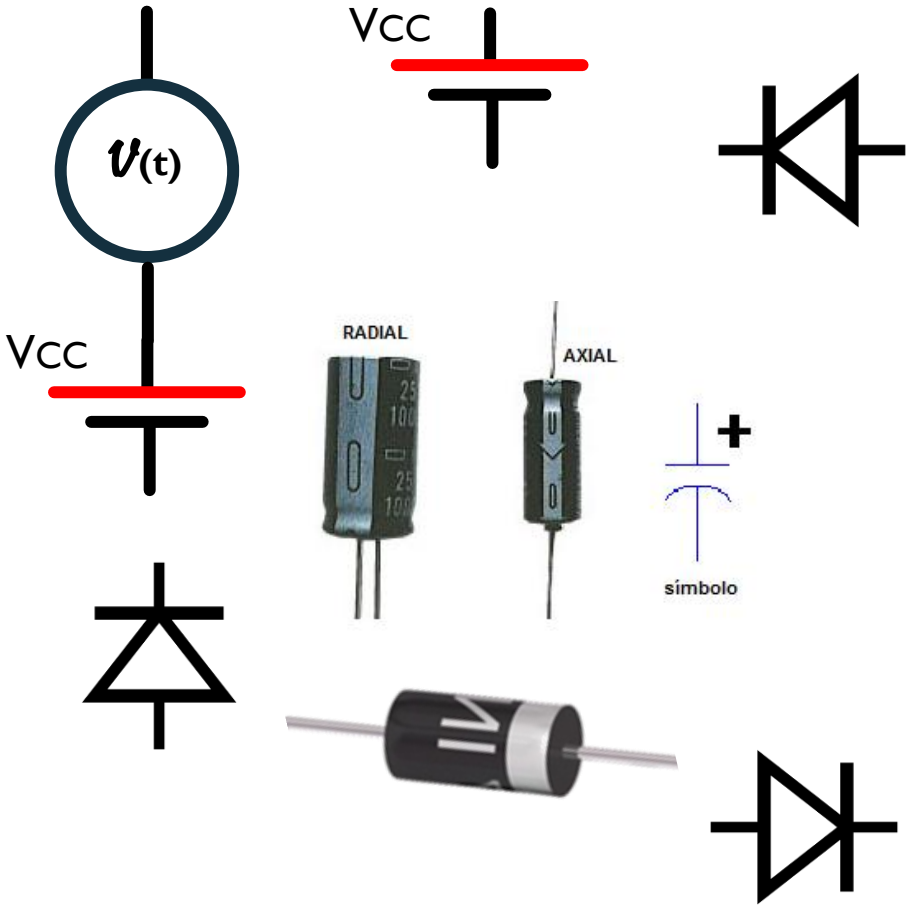
A	B	Vo
0	0	0
0	1	0
1	0	0
1	1	1

Porta lógica “E”

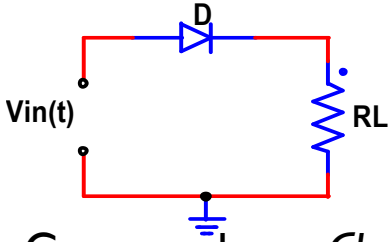


A	B	Vo
0	0	0
0	1	0
1	0	0
1	1	1

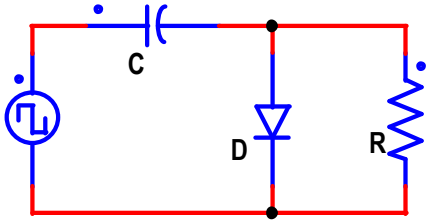
DIODO OPERANDO EM CC, CC + CA OU CA
CEIFADOR-GRAMPEADOR-MULTIPLICADOR



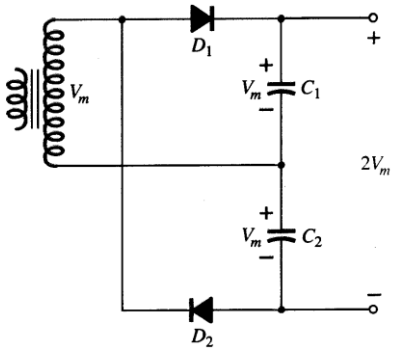
Ceifador = *Clipper*



Grampeador = *Clamper*



Multiplicador

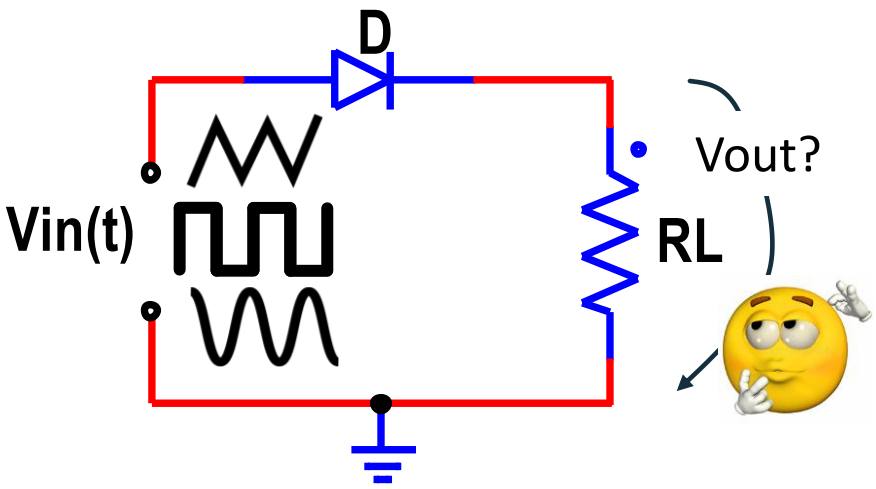


Circuito ceifador ou limitador (*Clipper*)

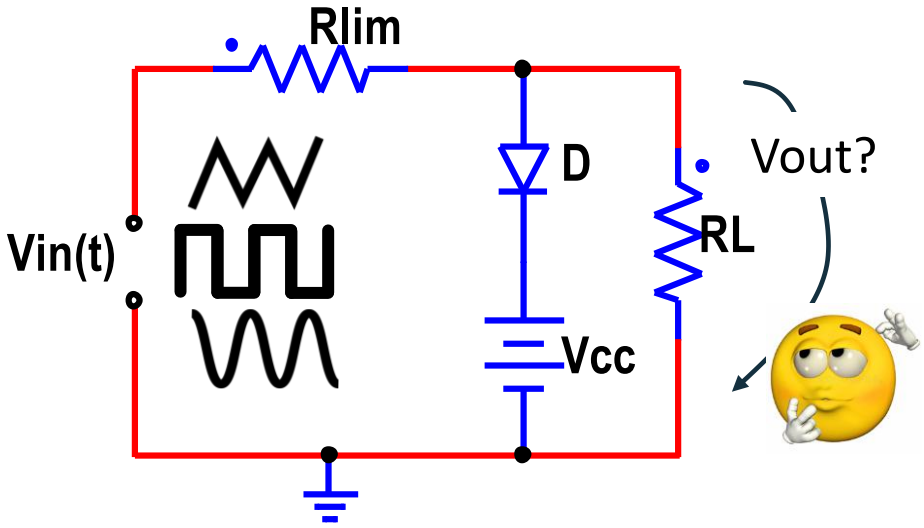
CEIFADOR: corta parte do sinal de entrada.

Circuitos que usam o diodo para modificar a forma de onda do sinal de entrada.
Conforme a polarização do diodo, parte do sinal de entrada pode ser mantida: a parte superior, inferior ou entre níveis.
O sinal de entrada "Vin" é uma tensão variável no tempo: senoidal, triangular, quadrada.

a) série: o diodo está em série com o resistor de carga.



b) paralelo: o diodo está em paralelo com o resistor de carga.

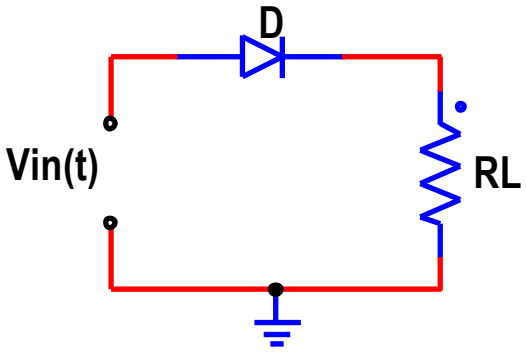


Malvino Online cap 4 p. 119
Repositório da disciplina

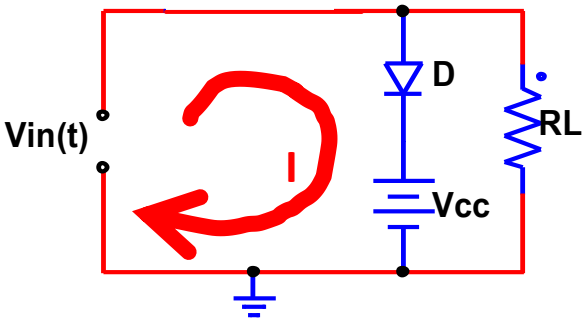
Por que existe o Rlim no circuito ?

Na verdade Rlim que pode se chamar de R1, Rk, ...

O diodo <u>real</u> é um componente cuja R_{diodo} é muito pequena. Se somente este componente estiver no circuito a corrente tenderá a um elevado valor. Desta forma a necessidade de um resistor limitador.

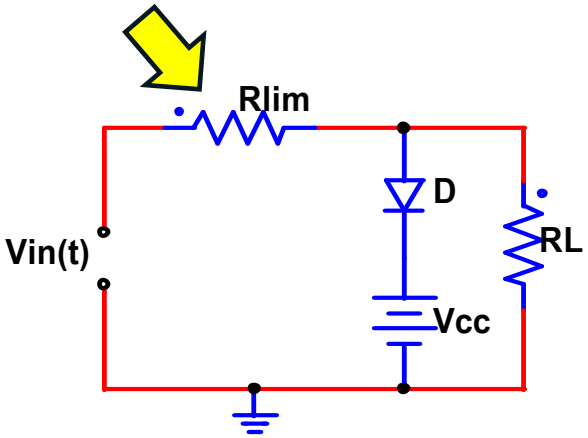


Neste circuito, a existência 'natural' do RL (pois é série) limita a corrente.



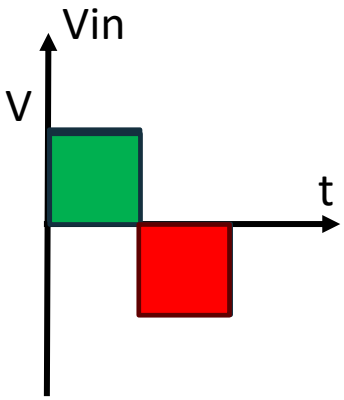
O diodo está em paralelo e, como sua R_{diodo} é baixa, a tendência é circular uma elevada corrente na malha Vin(t)-D-Vcc!

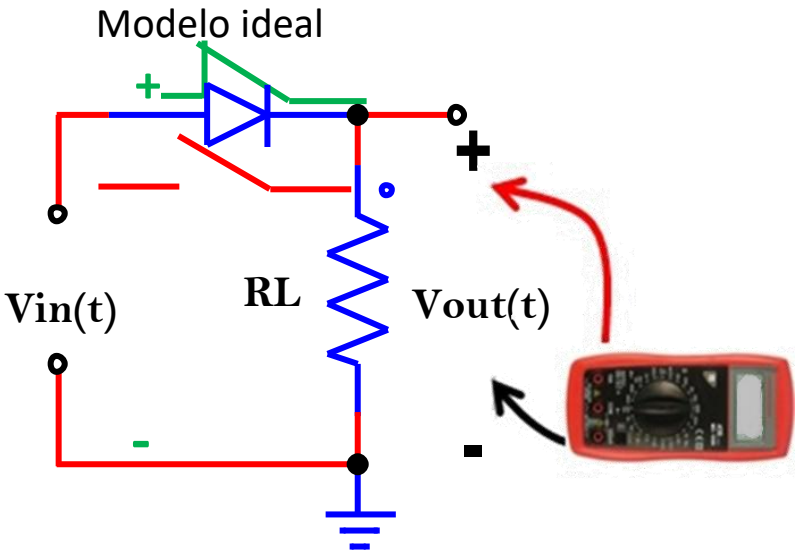
Portanto a necessidade de incluir um resistor **Rlim** com o objetivo de limitar a corrente quando o diodo conduzir.

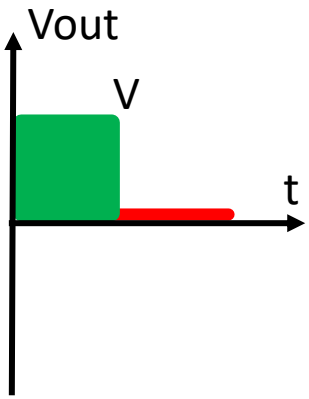


CEIFADOR SÉRIE (diodo está em série com a carga)

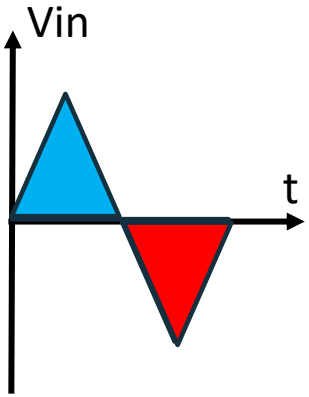
Ex1)Vin quadrada

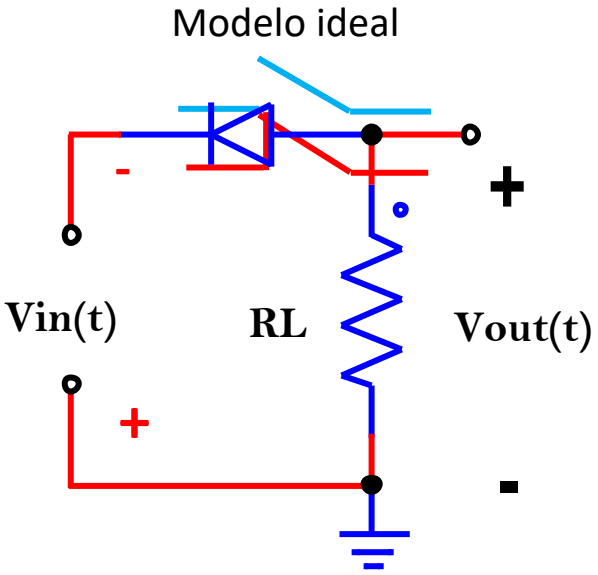


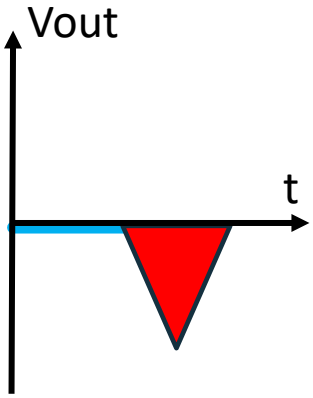




Ex2)Vin triangular

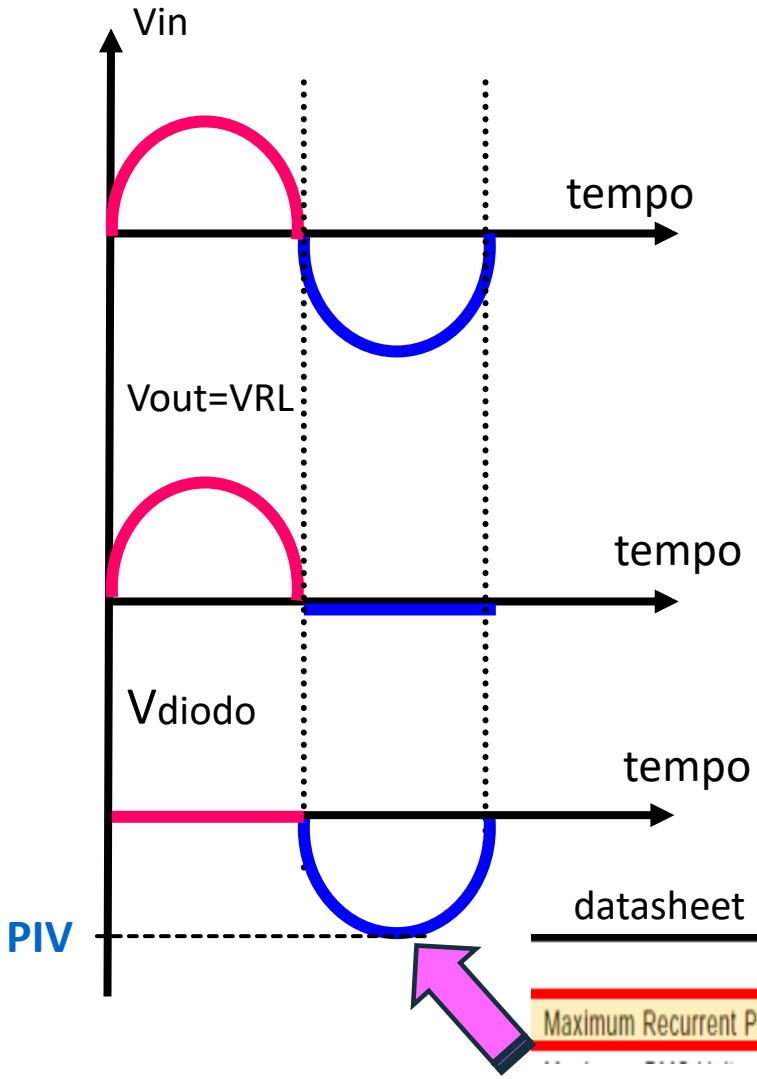


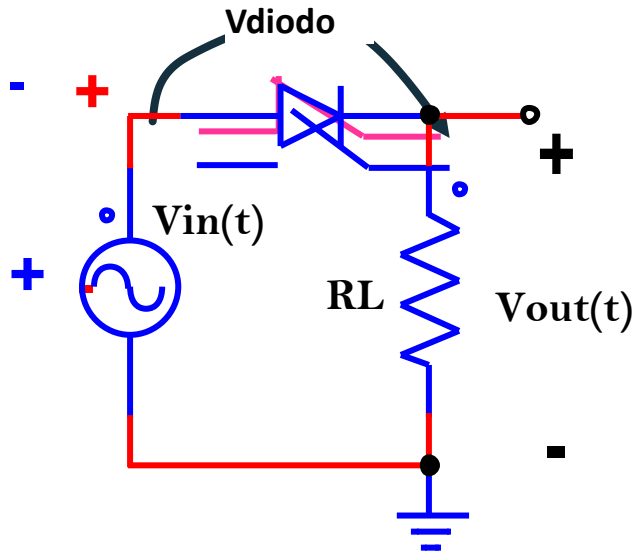




Ceifador série (diodo está em série com a carga)

Ex3)Vin senoidal: com modelo do diodo ideal





datasheet

RATINGS
Maximum Recurrent Peak Reverse Voltage

PIV = *peak inverse voltage*. Máxima tensão que o diodo suporta em polarização reversa.

Pode ser denominada como TPI,TPR (é aquela do datasheet da Rectron-V_{RRM}!!)

Datasheet: diodo Rectron

MAXIMUM RATINGS (At T_A = 25°C unless otherwise noted)

RATINGS	SYMBOL	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	UNITS
Maximum Recurrent Peak Reverse Voltage	V_{RRM}	50	100	200	400	600	800	1000	Volts
Maximum RMS Voltage	V_{RMS}	35	70	140	280	420	560	700	Volts
Maximum DC Blocking Voltage	V_{DC}	50	100	200	400	600	800	1000	Volts
Maximum Average Forward Rectified Current at T_A = 75°C	I_O	1.0							Amps
Peak Forward Surge Current 8.3 ms single half sine-wave superimposed on rated load (JEDEC method)	I_{FSM}	30							Amps
Typical Junction Capacitance (Note)	C_J	15							pF
Typical Thermal Resistance	$R\theta JA$	50							°C/W
Operating and Storage Temperature Range	T_J, T_{STG}	-65 to + 175							°C

ELECTRICAL CHARACTERISTICS (At T_A = 25°C unless otherwise noted)

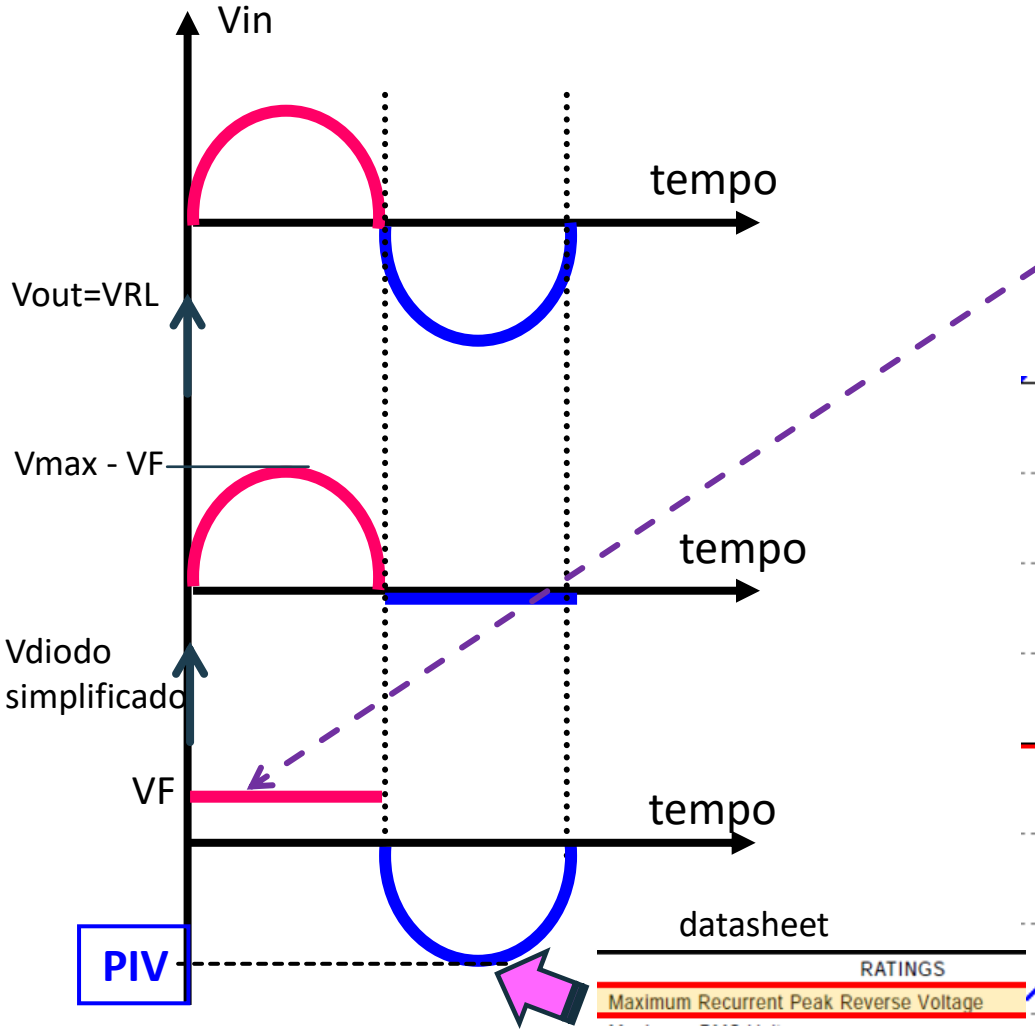
CHARACTERISTICS		SYMBOL	1N4001	1N4002	1N4003	1N4004	1N4005	1N4006	1N4007	UNITS
Maximum Instantaneous Forward Voltage at 1.0A DC		V_F	1.1							Volts
Maximum DC Reverse Current	@T_A = 25°C	I_R	5.0							uAmps
at Rated DC Blocking Voltage	@T_A = 100°C		50							
Maximum Full Load Reverse Current Average, Full Cycle .375" (9.5mm) lead length at T_L = 75°C			30							uAmps

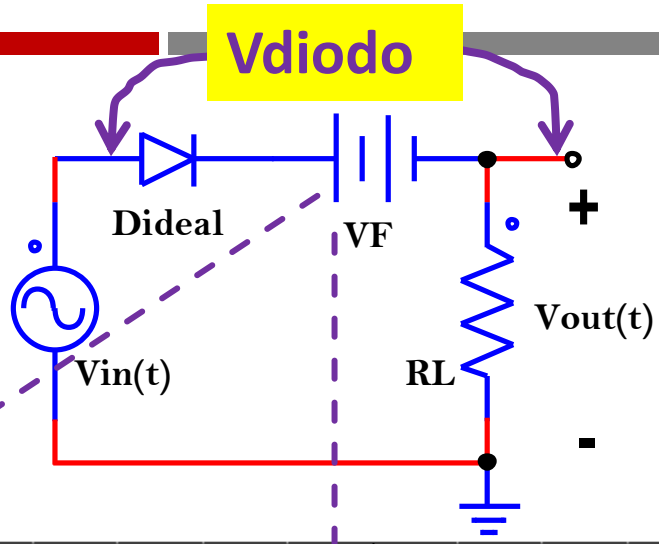
NOTES : Measured at 1 MHz and applied reverse voltage of 4.0 volts

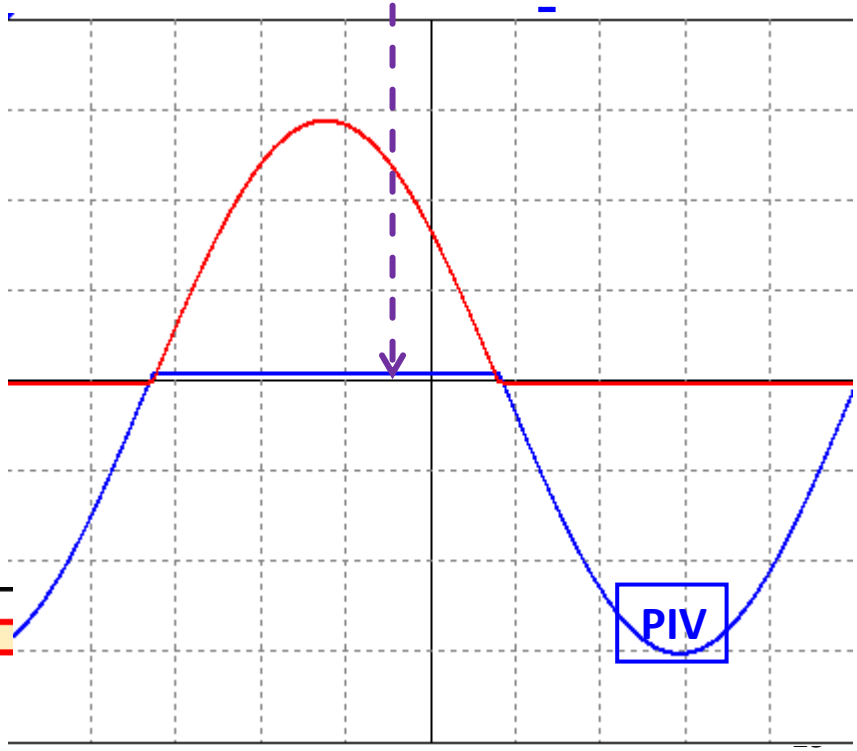
1998-8

Ceifador série (diodo está em série com a carga)

Ex4)Vin senoidal – diodo modelo simplificado

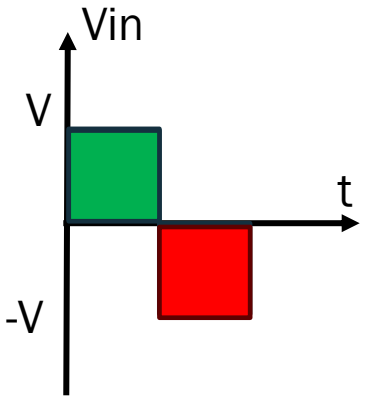


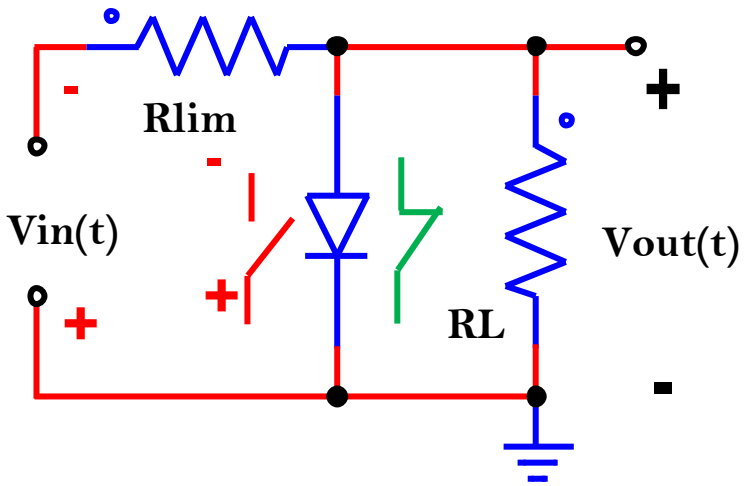


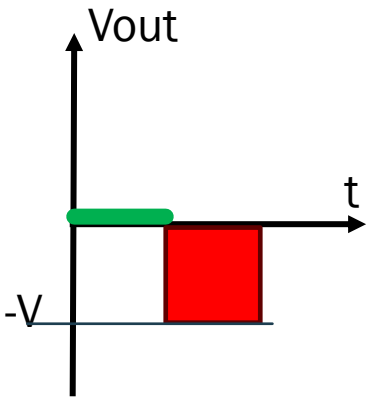


Ceifador paralelo

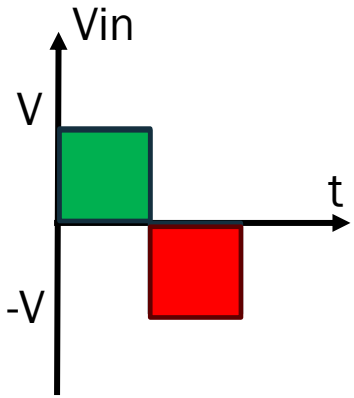
Ex5a) Diodo ideal

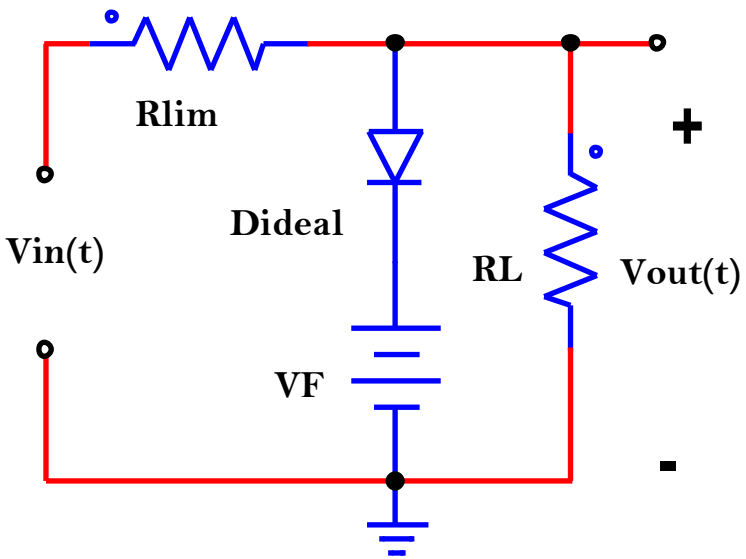


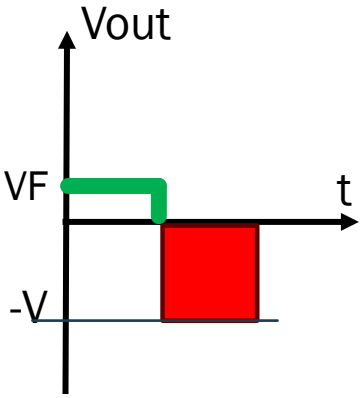




Ex5b) Diodo simplificado



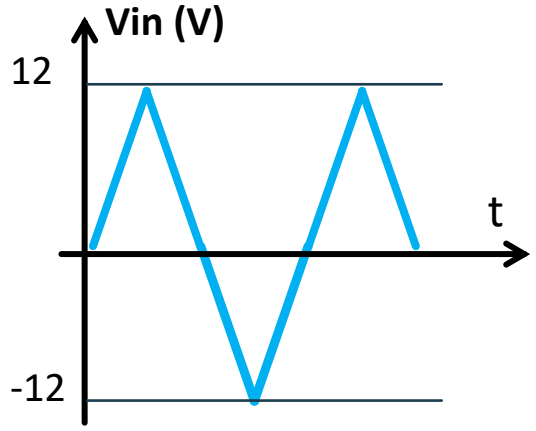


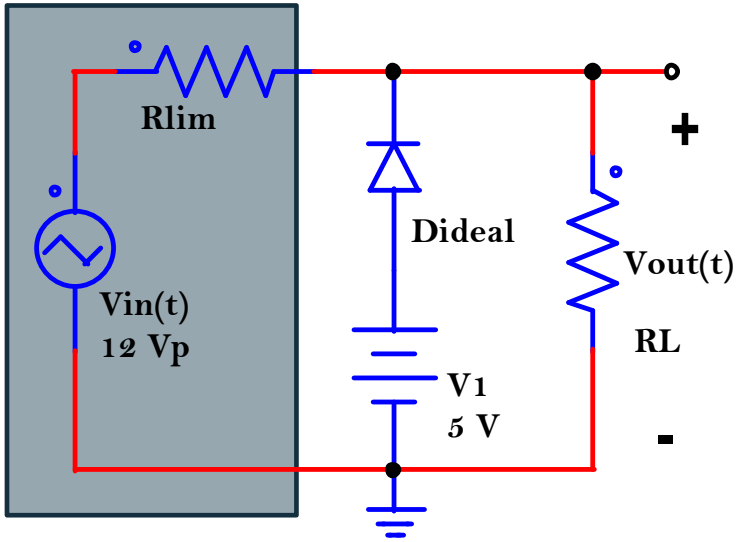


Para que o circuito apresente o comportamento informado, o valor de RS deve ser muito menor que RL. Como regra prática adota-se RS< RL/100.

Ceifador paralelo com fonte DC

Ex6)

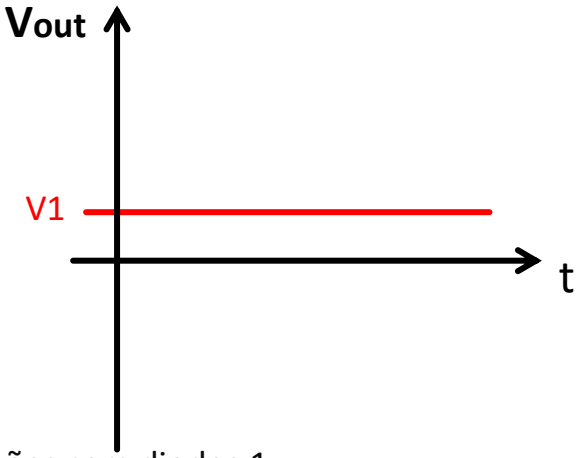


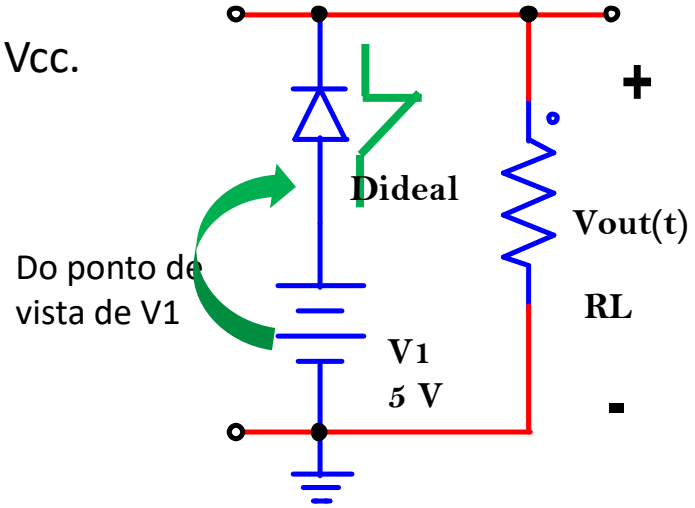


Solução:

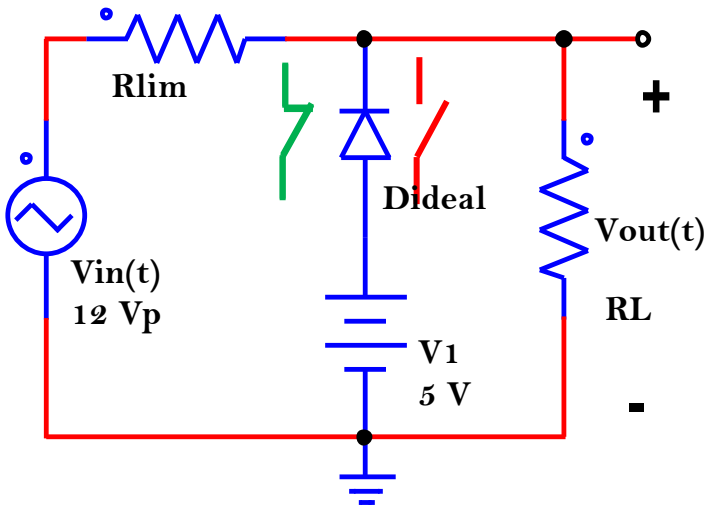
1)Inicie a análise pelos efeitos da fonte CC sobre o diodo.

2)Esboce a saída somente para a tensão Vcc.





Ceifador paralelo com fonte DC, continuação

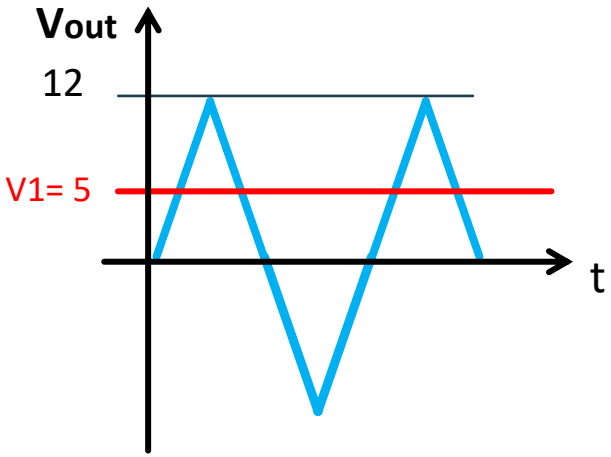


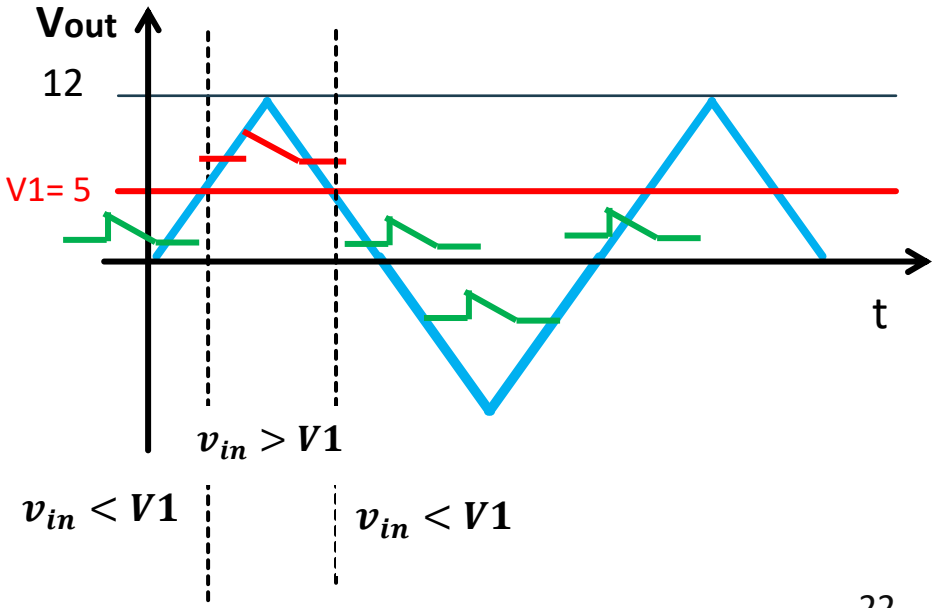
Solução:

1)Inicie a análise pelos efeitos da fonte CC sobre o diodo.

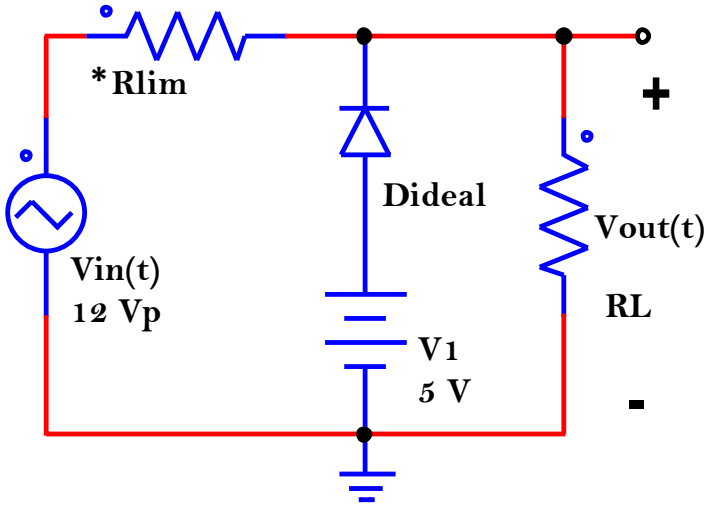
2)Esboce a saída somente para a tensão Vcc

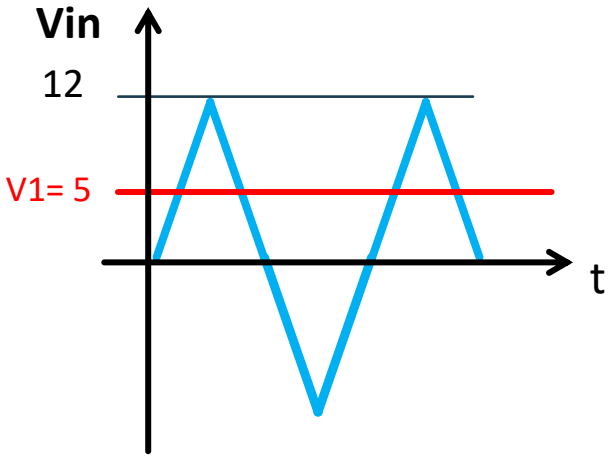
3)Inclua a fonte CA, repita a análise porém somente para a fonte CA.





Ceifador paralelo com fonte DC, conclusão

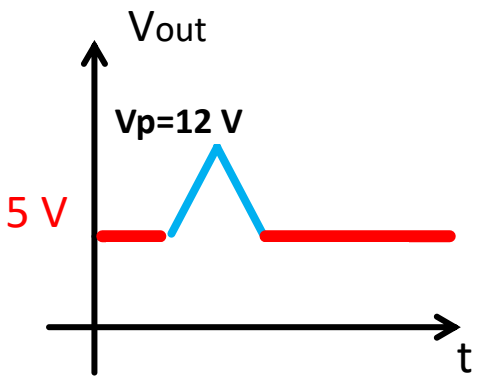




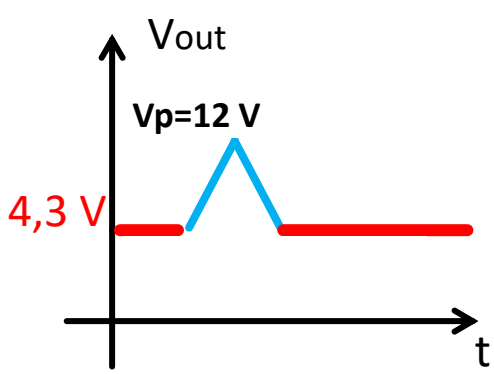
*Admite-se que o valor de Rlim seja pequeno suficiente para que Vout seja o mais próxima possível da Vin.

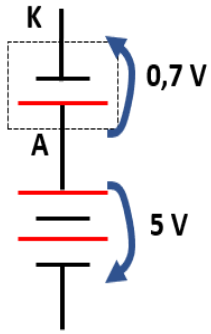
Forma final da tensão de saída - Vout

Para modelo ideal



Para modelo simplificado





Exercício: obtenha a curva de transferência Vout=f(Vin)

Curva de transferência ou característica de transferência: gráfico que apresenta o comportamento da variável de saída em função da variável de entrada: Out = f (In) que para este circuito é Vout=f(Vin).

Avalie como que a saída-Vout se comporta para uma tensão Vin variável entre 0 a 10 V.

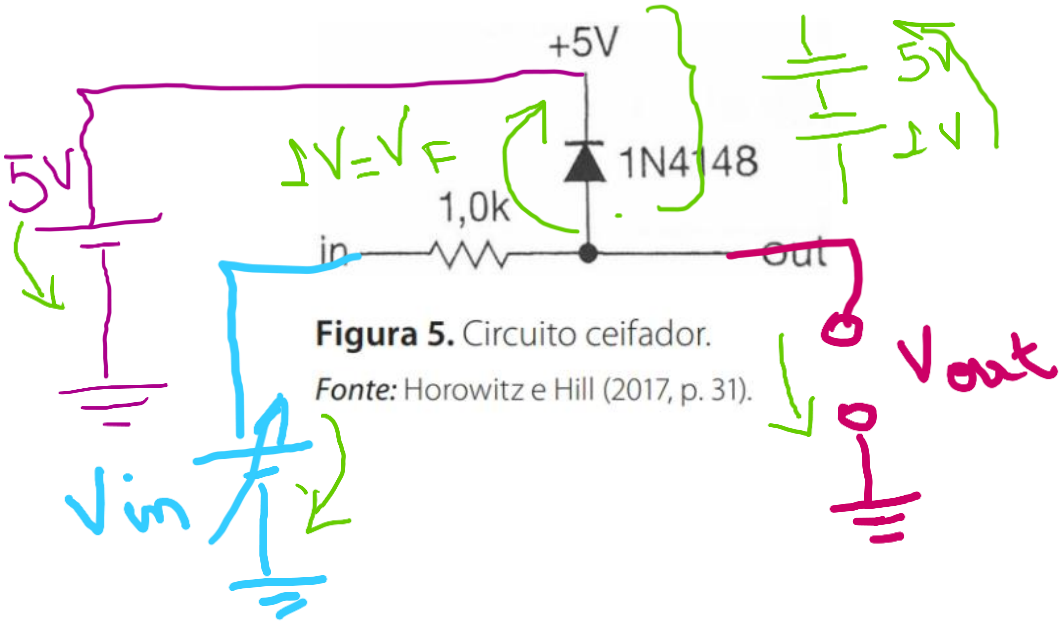
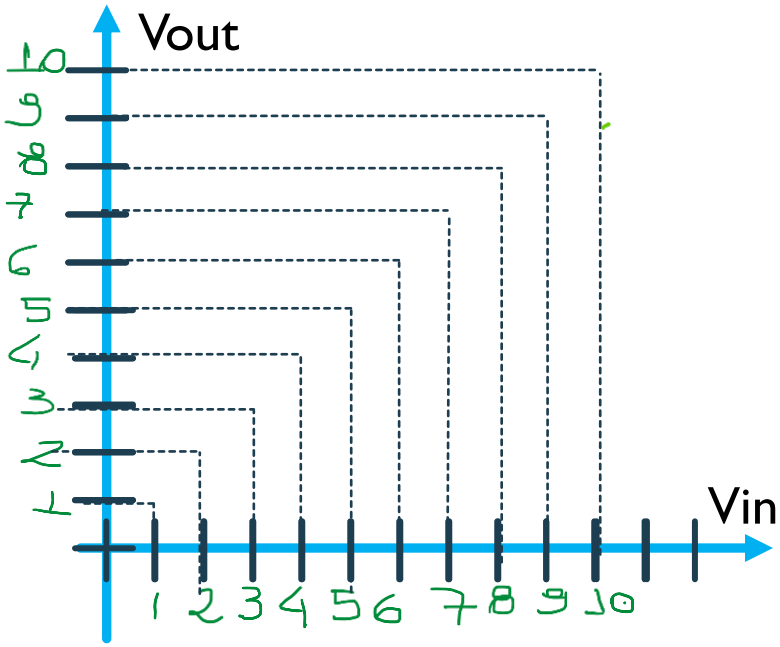


Figura 5. Circuito ceifador.

Fonte: Horowitz e Hill (2017, p. 31).



Datasheet: https://www.vishay.com/docs/81857/1n4148.pdf

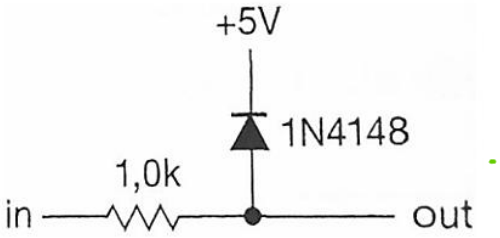
ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

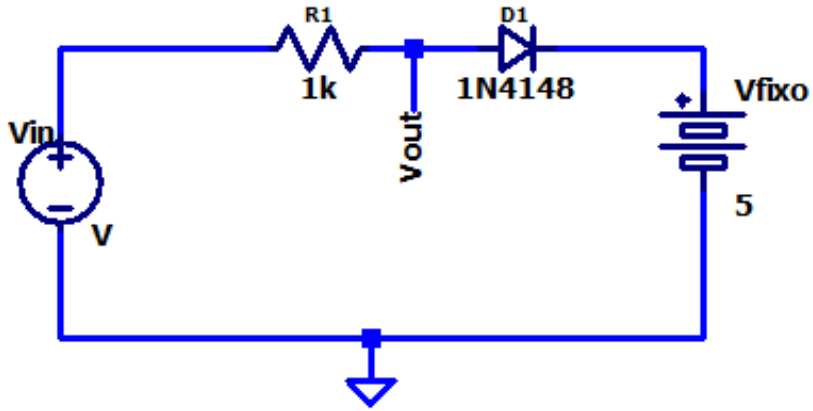
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 10 mA	V_F			1	V

Fonte: https://integrada.minhabiblioteca.com.br/#/books/9788595026773/cfi/47!/6/4@0.00:26.9

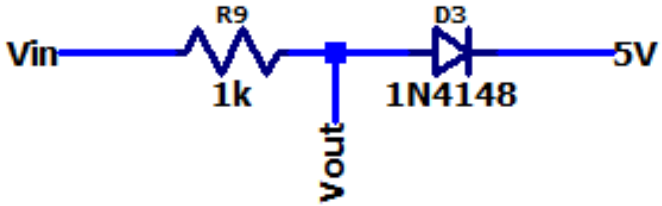
Obtenha a curva de transferência Vout=f(Vin)

Represente graficamente como que a saída-Vout se comporta para uma tensão Vin variável entre 0 a 10 V.

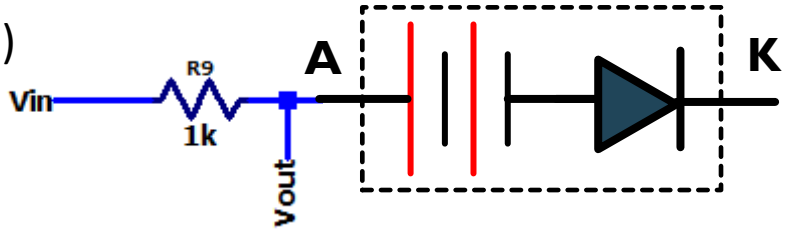




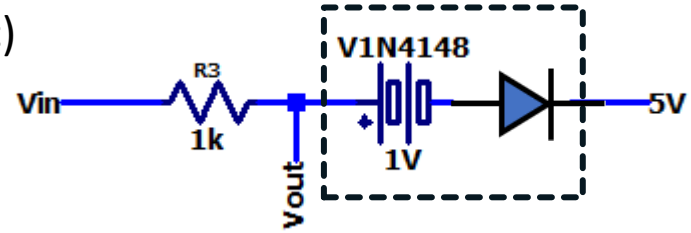
a)



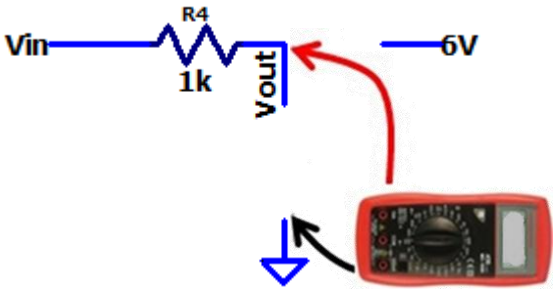
b)



c)

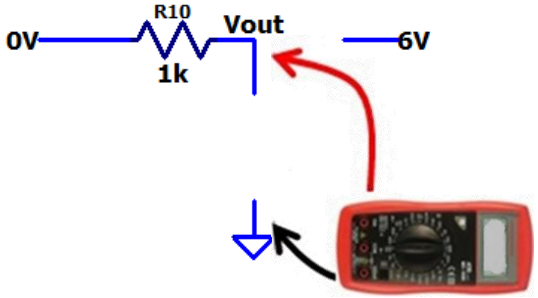


d)



e)

Vin = 0 V

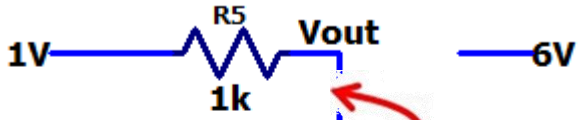


Vout = 0 V

Continuação

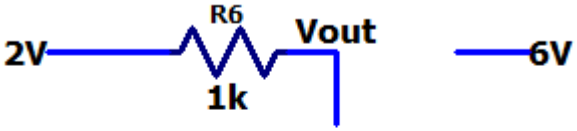
Avalie como que a saída-Vout se comporta para uma tensão Vin variável entre 0 a 10 V.

f) Vin = 1 V



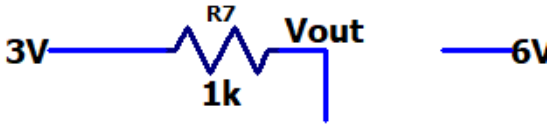
Vout = 1 V

g) Vin = 2 V



Vout = 2 V

h)



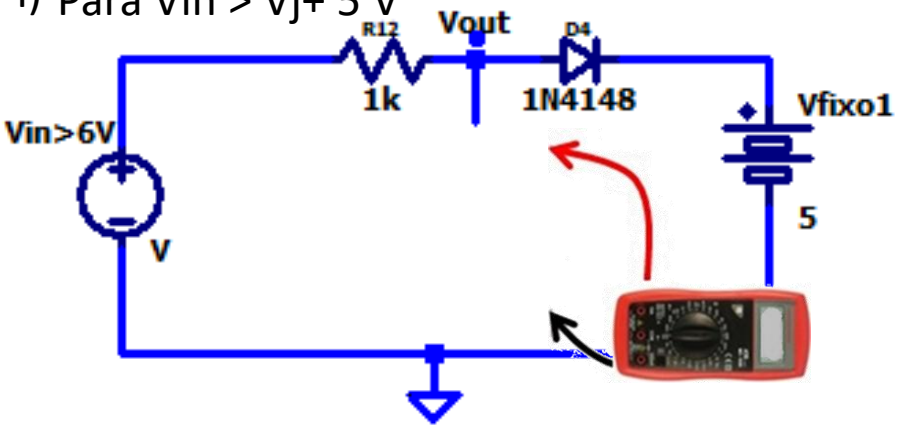
Vout = 3 V

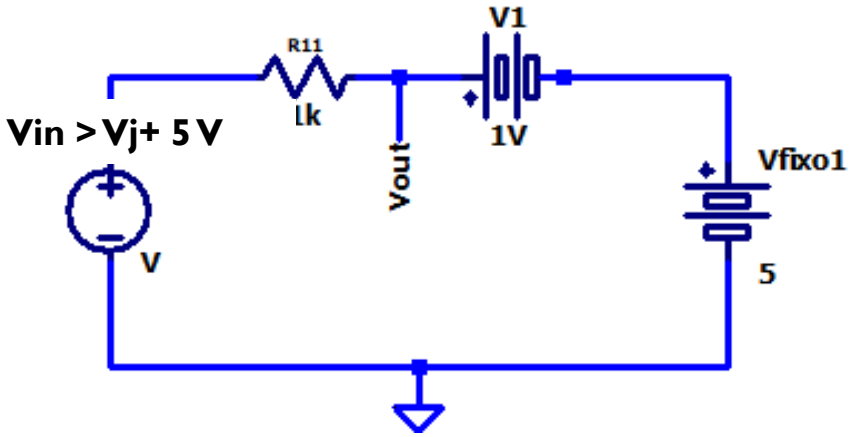
i) Vin = 6 V

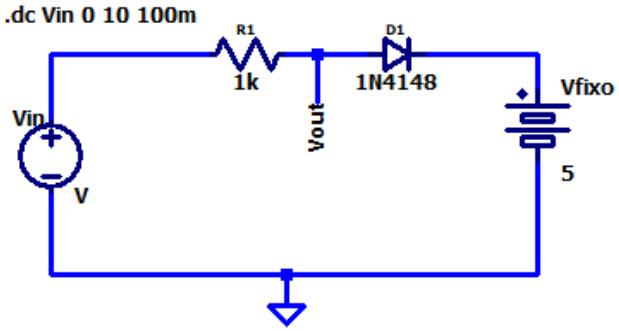
Vout = 6 V

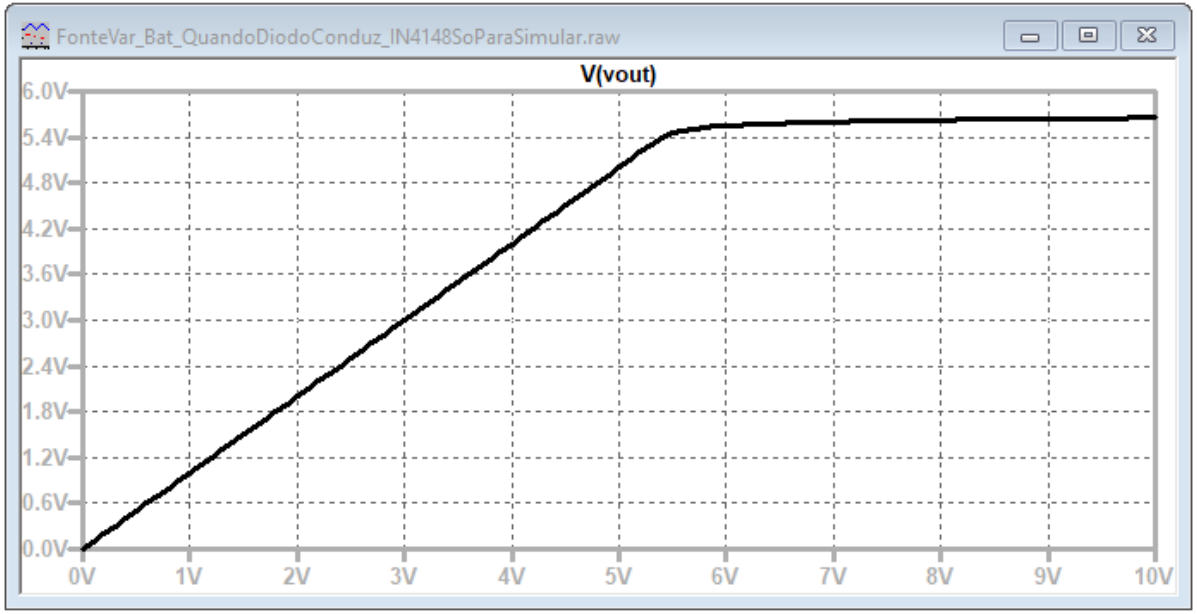
Continuação

i) Para Vin > Vj+ 5 V



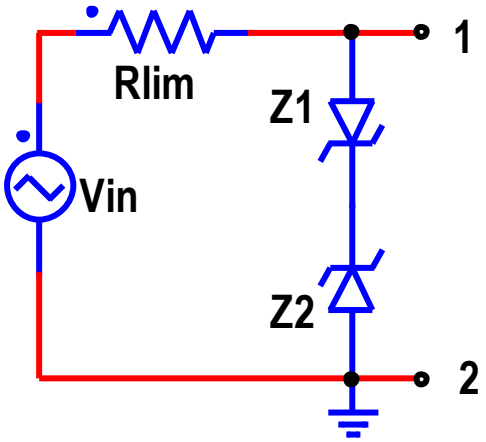


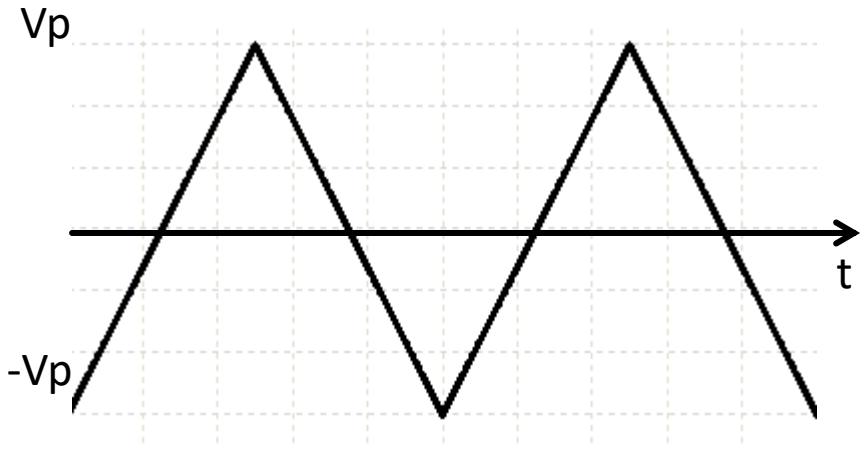


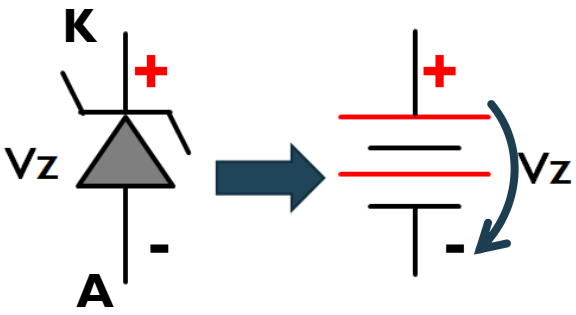


Circuito limitador com o zener

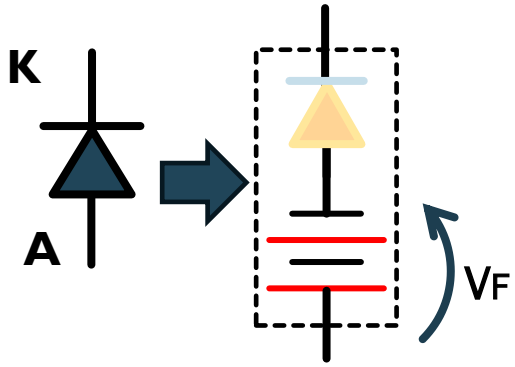
Obtenha a característica de transferência para o circuito a seguir.
Vz1/P1, V_{Fz1}= Vj1, Vz2/P2 , V_{Fz2}= Vj2, Vz1<|Vp| e Vz2 < |Vp|







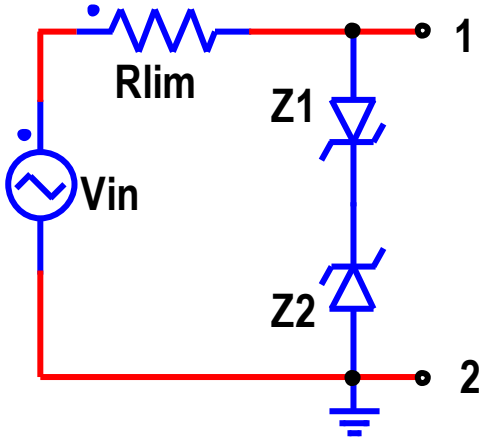
Modelo Zener

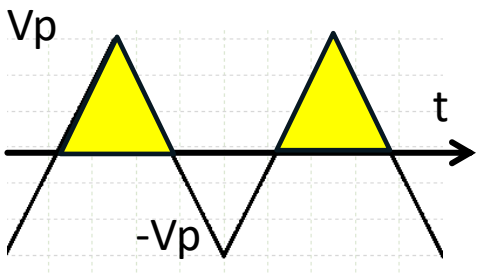


Modelo 2ª aproximação

Circuito limitador com o zener: semiciclo positivo

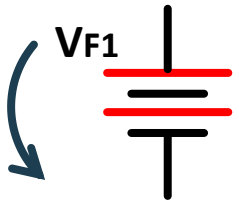
Vz1/P1, V_{Fz1}= Vj1, Vz2/P2 , V_{Fz2}= Vj2, Vz1<|Vp| e Vz2 < |Vp|

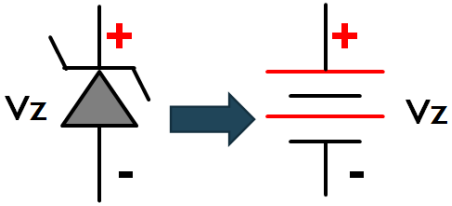


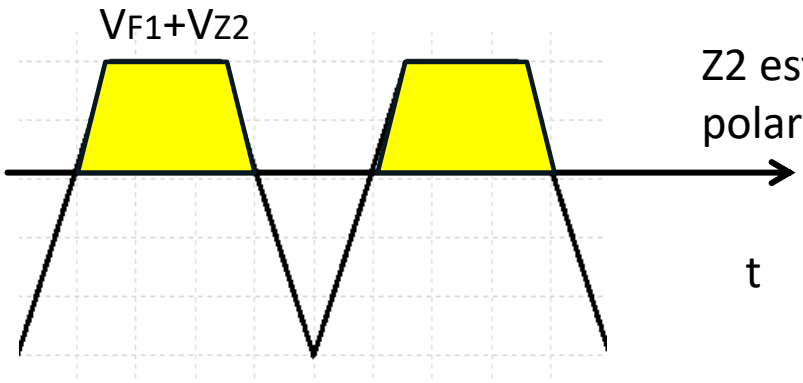


Análise semiciclo positivo:

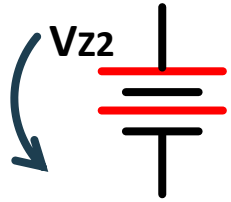
Z1 está diretamente polarizado: semelhante ao diodo => VF1

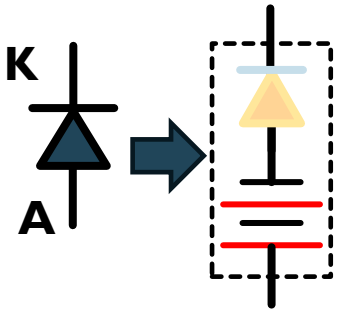






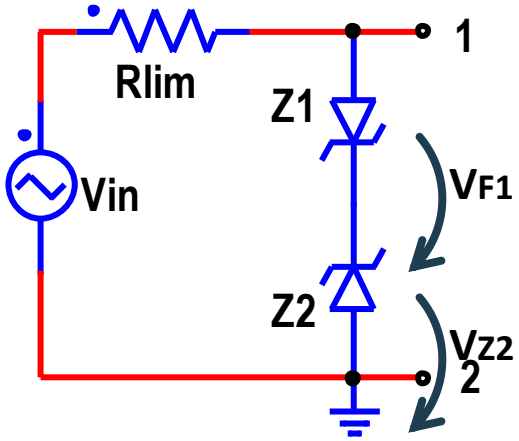
Z2 está reversamente polarizado: fonte de Vz2 volts

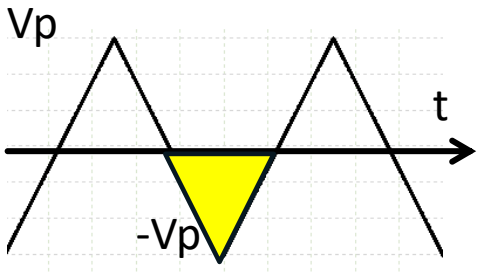




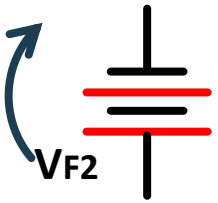
Circuito limitador com o zener: semiciclo negativo

Vz1/P1, V_{Fz1}, Vz2/P2 , V_{Fz2} ,Vz1<|Vp| e Vz2 < |Vp|

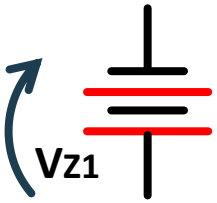


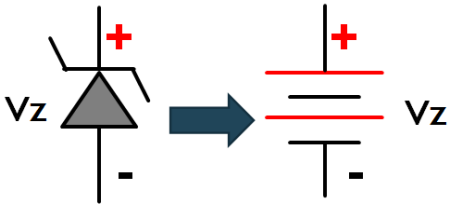


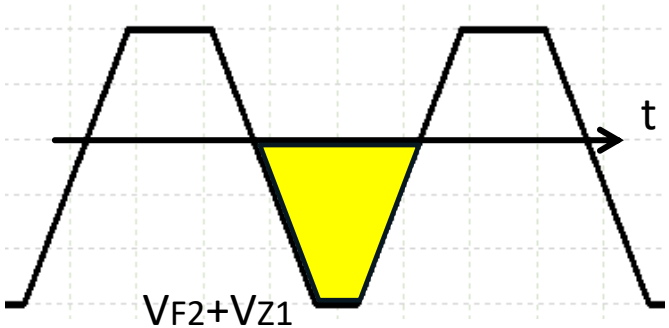
Análise semiciclo negativo:
Z2 está diretamente polarizado: semelhante ao diodo => VF2

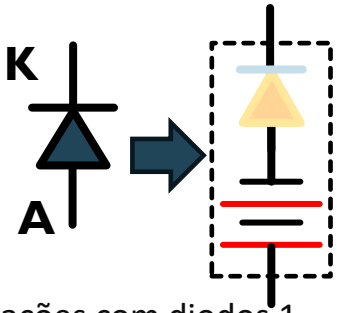


Z1 está reversamente polarizado: fonte de Vz1 volts



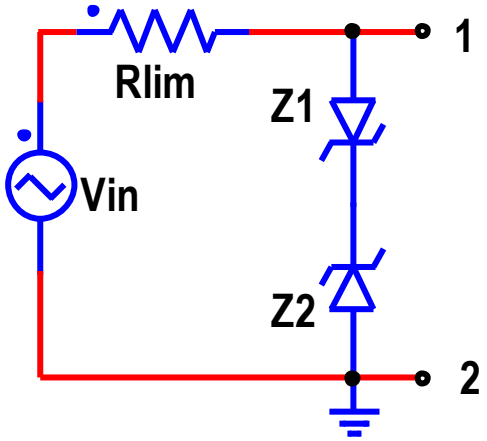


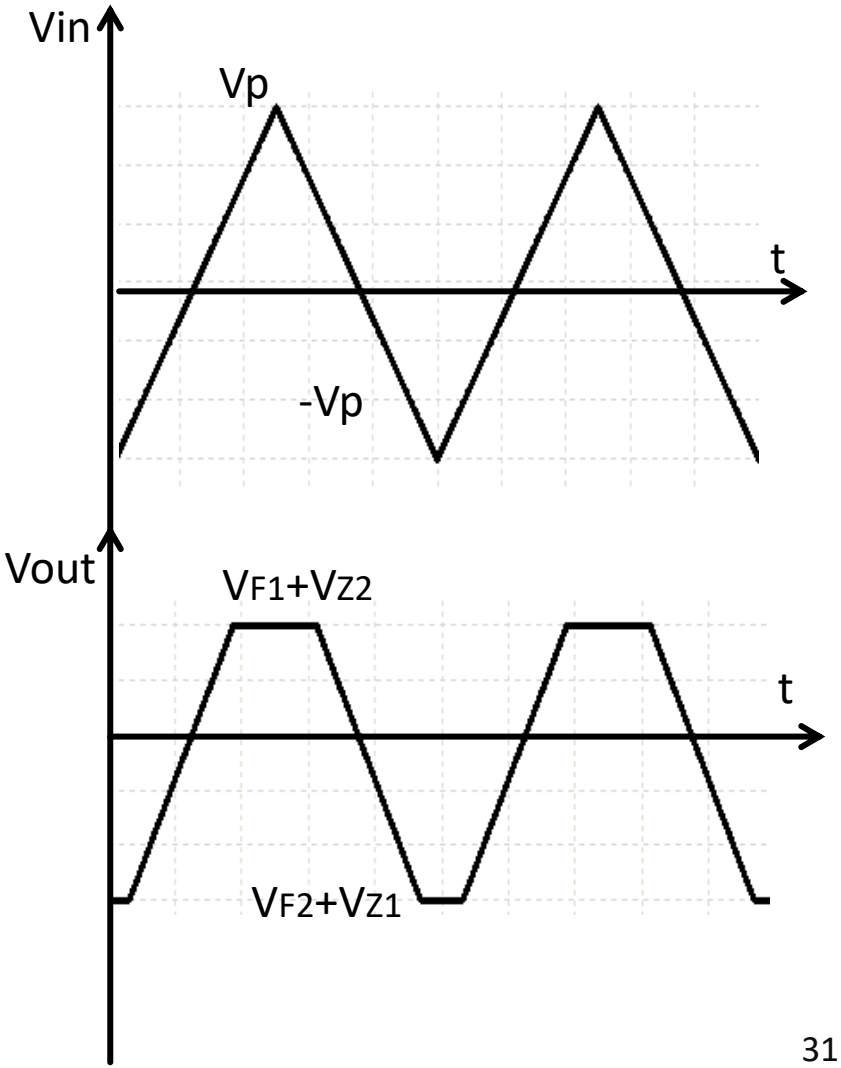




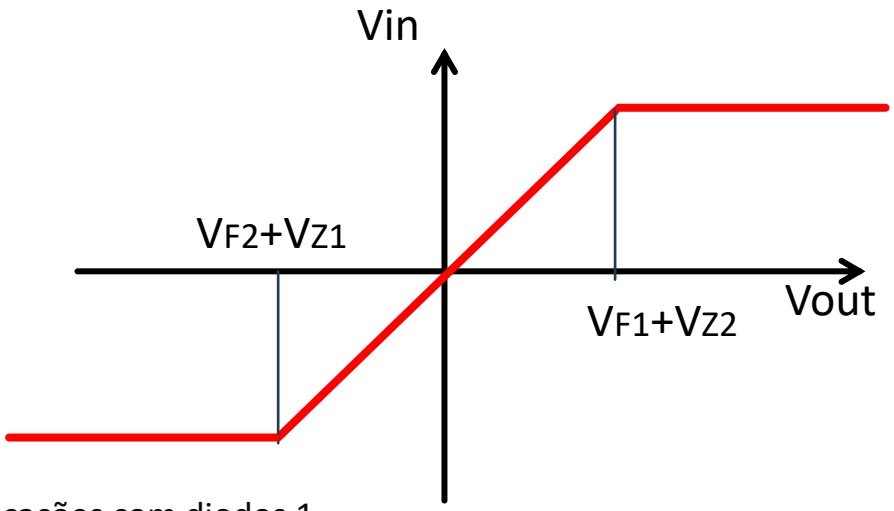
Circuito limitador com o zener

Obtenha a característica de transferência para o circuito a seguir.
Vz1/P1, V_{Fz1}, Vz2/P2 , V_{Fz2}, Vz1<|Vp| e Vz2 < |Vp|





Característica de transferência: Vout =f(Vin)



Circuito limitador com o zener

Obtenha a característica de transferência e a forma de onda da saída para o circuito a seguir.
V_{z1}= 5,1 V, V_{Fz1}= 0,7 V, V_{z2} = 6,8 V, V_{Fz2}= 0,7 V.